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Aircraft Measurements in the Northeast Pacific, Summer 1989

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Abstract

Between 25 June - 19 July 1989, an experiment deploying over 800 deep and shallow AXBTs was conducted in the subarctic frontal zone of the Northeast Pacific, between approximately 32° - 43° N, 138° - 151° W. The operation was part of the validation phase of the Naval Oceanographic and Atmospheric Research Laboratory's (NOARL's) Northeast Pacific Modeling Project (NEPAC). This document describes the experimental plan and the data acquisition and processing techniques used for the NEPAC experiment and presents the resulting data in graphical form.

Acknowledgments

The 30 research flights during the experimental period were made possible only with the help of a great many people. They included:

The officers and crew of the Naval Research Laboratory (NRL) aircraft #150607, CDR Robert Stephenson, commanding;
The officers and crew of the VXN-8 aircraft "Birdseye," LCDR H.S. Schaffer, commanding;
Gary Athey and Leonard Gordon, civilian employees of the Naval Oceanographic Office on board the VXN-8 aircraft;
The officers and crew from patrol squadrons VP-9, VP-46, VP-48, and VP-Mau who flew 9 flights for the experiment;
LT Jim Curtis of COMPATWINGSPAC, our point of contact at Moffett Field, who made many arrangements for our use of facilities and resources there;
LCDR Stephen Ambrose, LCDR Robert Quinn, AWC K. Bales, AOC George Miller and other members of Patrol Wing Ten who helped with aircraft scheduling, replay of mission data tapes, and many logistical matters;

and many others who remain anonymous but without whose assistance the experiment could not have been a success.

Bob Linzell of Neptune Technologies and Shirley Baker of Planning Systems, Inc., did much of the data processing.

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Aircraft Measurements in the Northeast Pacific, Summer 1989

Introduction

An extensive set of oceanographic measurements for three major experiments were obtained from research and operational P-3 aircraft during June and July 1989. These experiments were the Northeast Pacific (NEPAC) modeling project of the Naval Oceanographic and Atmospheric Research Laboratory (NOARL), the multi-institutional VAST project and the Downslope Conversion Experiment of the Scripps Institution of Oceanography. Over 1300 deep (nominally 760 m) and shallow (nominally 305 m) temperature profiles from airborne expendable bathythermographs (AXBTs) were obtained for the three experiments, as well as a number of sound speed profiles, current profiles, and drifter tracks from other types of air deployed instruments. This document provides an overview of the data obtained for the NEPAC experiment; data summaries for the VAST experiment and the Downslope Conversion Experiment are given in Boyd and Linzell (1990) and Boyd (1989).

The NOARL NEPAC modeling project is one of several projects which are developing oceanographic prediction systems based upon a hierarchy of nested numerical circulation models. The approach is to have a tactical scale (local scale) model nested within a regional model which is in turn nested within a global model. The NEPAC project has as its specific goal the development of an ocean environmental/acoustic prediction system for the subarctic frontal region of the Northeast Pacific Ocean. The primary objective of the aircraft operations for this experiment was to obtain initialization and validation data for the tactical scale model.

The operations also had three secondary objectives. The first was to acquire temperature transects along portions of tracks of the GEOSAT altimeter satellite so as to investigate the feasibility of using altimetry to monitor the North Pacific subarctic front. These data are included here. The second was to deploy from the aircraft six "minidrifters" (Pickett, 1989), A-size drifting buoys which transmit position, sea surface temperature, air temperature, and barometric pressure back 6 - 8 times per day via SERVICE ARGOS. The drifting buoy data will be presented in a later NOARL Technical Note. The third objective was to deploy AXBTs and AXCPs (air deployed expendable current profilers) along six tracks crossing the subarctic front for a Naval Postgraduate School/University of Miami experiment. The current profiler data will be reported on elsewhere.

Experimental Plan and Operations Description

The study area lay between about 32 - 43° N, 138 - 151° W. All flights originated from Moffett Field, California. A summary of all flights for the three experiments is given in Table 1, and a composite of all NEPAC drop positions is shown in Fig. 1. The experimental plan was to obtain three near-synoptic realizations of a basically rectangular area, as shown in Figs. 2a, 2c, and 2e. A central portion was designated an intensive study area in which detailed tactical scale modeling was to be attempted; AXBTs were dropped around the boundary of this region between the first and second grids (Fig. 2b) and the second and third grids (Fig. 2d). Spacing between drops in the grids was 20 nmi (37 km) along track and 30 nmi (56 km) between tracks. Spacing between drops on the boundary flights was 20 nmi (37 km). Three flights were flown along GEOSAT tracks (Figs. 3a, 3b, and 3c), with an along-track spacing of 11 nmi (20 km). In general, deep (nominally 760 m) and shallow (nominally 305 m) AXBTs were alternated along the tracks. Table 1 summarizes average speeds and altitudes for the various flights.

Table 1. Summer 1989 NEPAC/VAST/Downslope Aircraft Speed and Altitude Summary

Date 1989	Flt #	Flight Description	Aircraft	True Airspeed, knots	Ground Speed, knots	Altitude kft	Navigation Error, nmi/km	System Used; Comments
25 June	101	NEPAC Grid A1#1	VXN-8	330	330	24.5-26.5	7.1/13.1	Inertial
26 June	102	NEPAC Grid B#1	VXN-8	330	330	24.5	2.1/3.9	I
	1	NEPAC Grid C#1	NRL	200	300	24.5	1.0/1.76	I
27 June								
28 June	301	NEPAC Grid D1 *	VP-9	230	220	12.5-14.4	N/A	
	103	NEPAC GEOSAT#1	VXN-8	230	240	10-10.5	3.5/6.2	I
	2	NEPAC Special Probes#1	NRL	200	190	5.0	0.1/0.2	Omega
29 June								
30 June	3	NEPAC GEOSAT#2	NRL	240	250	15.5-19.5	0.5/0.8	O
	104	NEPAC Boundary#1	VXN-8	330	330	22.5-25.5	1.1/2.1	I
1 July								
2 July								
3 July	4	NEPAC Special Probes#2	NRL	200	190	5.5	1.1/1.9	O
4 July	105	VAST Line W#1	VXN-8	225	230	2.8	1.6/2.8	I
5 July	202	Downslope#1 **	VP-9	200	200	3.0	4.5/7.9	I
6 July	106	VAST Line W#2	VXN-8	230	230	3.0	0.5/0.9	I;Estimate
	203	NEPAC Grid A2 **	VP-9	330	360	27.0	2.0/3.5	I
7 July	107	NEPAC Grid C#2	VXN-8	330	320	20.5	1.4/2.5	I;Est.
	304	NEPAC Grid D2#1 *	VP-46	N/A	220	10.5	N/A	
	5	NEPAC Grid B#2	NRL	310	300	20.5	1.6/1.1	O
8 July	205	Downslope(SUS)#2 **	VP-9	220	200	1.5	2.0/3.5	N/A;Est.
9 July	6	VAST Line W#3	NRL	225	220	2.0	7.3/13.5	I
10 July	7	VAST Line F#1	NRL	220	200	2.5	0.2/0.4	O
	206	Downslope#3 **	VP-9	200	190	2.0	0.2/0.3	O
	307	NEPAC Grid E *	VP-48	200	N/A	20.0	N/A	
11 July	308	NEPAC GEOSAT#3 *	VP-46	220	N/A	10.0	5.4/10.0	I
12 July	108	VAST Line F(SUS)#2	VXN-8	225	225	2.0	1.4/2.6	I
	209	NEPAC Boundary#2 **	VP-48	230	220	10.-16.	N/A	
13 July	109	VAST Line B (SUS)	VXN-8	220	230	2.-3.	0.5/0.9	I
14 July								
15 July								
16 July								
17 July	8	NEPAC Special Probes#3	NRL	215	200	5.-7.5	0.4/0.7	O
	210	NEPAC Grid A1#2 **	VP-48/MAU	240	260	5.0	N/A	
18 July	9	NEPAC Grid C#3	NRL	290	280	19.5	0.2/0.4	O
19 July	211	NEPAC Grid B#3 **	VP-48	300	290	24.5	0.5/0.9	O;Est.
	312	NEPAC Grid D2#2 *	VP-48	N/A	N/A	N/A	N/A	

* => VP ACFT

** => VP ACFT with Isis system on board

Notes: Air speed and ground speed values are approximate averages. Altitudes are also approximate averages, except where ranges are indicated; these numbers show the minimum and maximum altitudes listed in the navigation logs. Navigation errors are one half the navigation error upon landing. "N/A" indicates the information was not available. "I" or "O" indicate that Inertial system or Omega system was used for navigation. "Estimate" or "Est." indicate that the error was estimated by a P-3 crew member; other navigation error information was not available.

Personnel

The civilian personnel participating in part or all of the experiment were:

Dr. Janice Boyd	NOARL	Chief Scientist
Richard Myrick	NOARL	
Stephen Sova	NOARL	
Shirley Baker	Planning Systems, Inc.	Ground Station Manager
Robert Broome	Planning Systems, Inc.	
Peter Flynn	Planning Systems, Inc.	
Michael Wilcox	Planning Systems, Inc.	

Data Collection and Processing

All AXBTs (US Navy designation AN/SSQ-36) were manufactured by Sippican Ocean Systems, Marion, MA, under two contract numbers. The overall failure rate was 33 out of 847, or 3.9%. A summary of the contracts, lots, number dropped, and number of failures is given in Table 2.

Table 2. Summary of AXBT contract numbers, lots, number deployed, number failed, and failure rates. A failure rate of 5 - 10% is normal. Shallow (nominally 305 m) AXBTs had a NALC (Navy Ammunitions Logistics Code) of 8W59 and deep (nominally 750 m), 8W52.

	Contract N00163-87-C-001		Contract N00163-85-C-001	
	Shallow	**Deep**	**Shallow**	**Deep**
Lot numbers:	03,14,17,27,29	27	11,12,16,17,20,21, 22,24,26,27,30	21,24,27
# Dropped:	277	424	135	11
# Failures:	10	8	14	1
Failure rate:	3.6%	1.9%	10.4%	9.1%

Acquisition

Three different systems were used in data collection. The NOARL Physical Oceanography Branch (Code 331) Isis system was used on all NRL aircraft flights and most VP-squadron flights (see Fig. 4). Fig. 5 outlines the capabilities of the Isis system, which allows full processing and considerable analysis of the data

to be completed in the field. The Naval Oceanographic Office's (NAVOCEANO's) ADAPS (Airborne Data Acquisition and Processing System) system was used on the VXN-8 aircraft. On the VP-squadron flights for which no Isis system was installed, the AXBT signals were recorded on the 14-track mission data tapes and the tapes were later played back in the ASWOC (ASW Operations Center) into an Isis unit. A problem with the mission data tapes made the replayed data for the 10 July NEPAC Grid E flight so noisy as to be unusable.

Data was transmitted from the AXBTs as a frequency modulated signal on one of three standard carrier frequencies (channel 12 or 170.5 MHz, channel 14 or 172.0 MHz, and channel 16 or 173.5 MHz). Typically all three channels were transmitting at the same time. The signals were picked up by standard Navy sonobuoy receivers, and either sent to the on-board 14 track tape recorder (in the case of Fleet aircraft without the Isis system on board), or else they were amplified, and sent to either the Isis or the ADAPS data interface unit where they were again amplified and filtered, digitized and sent along a 16 bit parallel GPIO interface bus to the acquisition computer, a Hewlett-Packard 9000 model 320 (ADAPS) or 330 (Isis). With the Isis and ADAPS systems, the incoming signal was also sent to a VCR-based backup recording system for later replay, if necessary. No degradation of data quality is noticed when data is replayed.

With both the Isis and ADAPS systems, the HP 9000 acquisition computer subsampled each input data stream at 10 Hz (about every 15 cm in depth) and displayed the data in real time on the CRT display. Upon termination of an AXBT the data was stored on 3.5" microdiskettes. The data on the microdiskettes was then read into a PC-AT compatible microcomputer where it was processed and plotted. As the NAVOCEANO ADAPS interface unit is an earlier version of the Isis unit, complete compatability existed between both acquisition systems and the Isis processing and analysis modules. Usually processing was completed on the return leg of the flights.

Navigation

The on-board inertial and Omega navigation systems were used on each aircraft. The navigation system was initialized as part of pre-flight procedures and the system position drift was usually recorded at the conclusion of the flight. If system drift is reasonably linear with time, the mean position error can be taken as about one-half of the error at the flight's conclusion. The mean position errors are listed in Table 1. Drop position accuracies are generally taken to be 1.5 times the navigation accuracy. To estimate drop position errors for the flights in Table 1, multiply the given position error by 1.5. The wide variations in errors from flight to flight are typical.

On board the NRL and VXN-8 aircraft the drop positions were automatically recorded by the data acquisition system as a probe was launched. On Fleet aircraft the AXBT positions were automatically logged by the onboard CP 901 computer system. Positions were later transcribed by hand from the mission printout and merged with the data.

Initial Data Processing

The data from the 3.5" microdiskettes was read into 80386 PC computers for processing. A 21 point (2.1 second) median filter was applied to remove most of the one to several point data spikes and other "glitches" that occur in the data for various reasons and to filter out much of the high frequency noise. The raw data was then converted to engineering units using the Navy standard conversion equations. For temperature this is

$$T = -40.0 + 0.02778\ F,$$

where F is frequency in hertz and T is temperature in °C. The Navy standard requires the temperature accuracy to be about ±0.55 °C within the range from -2° to 35 °C, but the probes marketed by Sippican are known to be accurate to about ±0.2 °C (e.g., Boyd, 1987).

The Navy standard elapsed-fall-time to depth conversion equation is

$$z = 1.52\ t,$$

where z is depth in meters and t is elapsed time after probe release in seconds. The standard requires the depth to be accurate to ±5% down to 305 m, and studies done on earlier versions of the deep and shallow AXBTs showed the depth error was bounded by this value throughout the appropriate depth ranges of the probes (Boyd, 1987).

After conversion to engineering units, if necessary, navigation information was merged with the data, the data were decimated to a 1-meter resolution, and a final 9-point median filter was applied to complete the smoothing process. The processed data were then visually scanned, primarily to find occasional data spikes at the very beginning or end of the profile which were not removed by the filtering process. These and a few other problems were removed using the Isis system interactive data editor, and the data were archived in the standard Isis archive format in 2-meter resolution and major temperature inflection point forms.

Depth Equation Corrections

About six months after the experiment, another set of data became available which allowed considerable improvements to be made to the shallow and deep AXBT fall rate equations. A series of shipboard CTD (conductivity-temperature-depth) stations were taken in the study area as part of the VAST experiment. As these observations included direct measurement of pressure, accurate depth versus temperature profiles could be constructed for those stations (accurate to ±1 m in depth for the prevailing conditions and processing techniques). A significant number of deep AXBTs were dropped near the stations, so the following statistical procedure was developed for calculating an improved depth equation for deep AXBTs. This improved equation was then used in the comparison of adjacent shallow and deep AXBTs, and an improved shallow AXBT fall rate equation was determined.

Deep AXBTs dropped within 30 km and 12 hours of a CTD cast were used. The depths of 15 isotherms were determined for both the deep AXBTs and the CTDs, and linear regressions of AXBT depth versus CTD depth were computed for the resulting 202 data points (see Fig. 6). Based on earlier work, a quadratic equation for deep AXBT depth was expected, but in this study the quadratic term coefficient was never found to be significantly different from zero, probably due to the inherent variability of measurements separated this far in both space and time. However, a significant modified linear term coefficient was found, giving a new equation of

$$z_{DAXBT} = 1.6094\ t$$

where z is depth in meters and t is elapsed time in seconds. The correlation coefficent was significantly different from zero at a 95% confidence level. The resulting corrected depths compared much more favorably with the CTD depths (Fig. 7).

During the GEOSAT lines on 28 and 30 June and 11 July 1989, deep and shallow AXBTs were dropped sequentially at an 11 nmi (22 km) separation Depths of 13 isotherms from the shallow AXBTs were compared with the corrected depths from the adjacent deep AXBTs (Fig. 8). Linear regressions of shallow AXBT depth versus corrected deep AXBT depth were computed. Again the quadratic term was never

significantly different from zero. The resulting corrected shallow AXBT fall rate equation was

$$z_{SAXBT} = 1.4969\ t$$

where z is depth in meters and t is elapsed fall time in seconds. The correlation coefficient was significantly different from zero at a 95% confidence level. The resulting depth correction, while subtle (Fig. 9), is important, particularly for maintaining consistency in the depths of features when deep and shallow AXBTs are dropped alternately.

Final Data Processing

The depths of all profiles were corrected according to the above equations. The temperature profiles were then merged with climatological temperatures using a procedure which reduces the deviation between actual temperature and climatological temperature exponentially with depth until the climatological temperature is reached. The scale depth for the merge was chosen as 500 m, and the climatology was the Navy standard GDEM (Generalized Digital Environmental Model) climatology for the summer season. GDEM has values at every half degree of latitude and longitude. The climatological profile was computed as the weighted mean of the nearest four GDEM values, weighted by the fractional N-S and E-W distances. Profiles were extended from surface to ocean bottom, with the bottom depth being taken as that from the Navy standard DBDB5 bathymetry, which comes on a five minute grid. Values were interpolated the same way as with climatology, the weighted mean of the four nearest values, weighted by the fractional N-S and E-W distances.

A salinity profile was then computed for each temperature profile using climatological or CTD T-S-z relationships. If no CTD cast was within 60 km (approximately one horizontal correlation scale), only the T-S-z relationship from the interpolated GDEM climatological profile was used. If a CTD was within 60 km, the mean profile was calculated with the addition of the CTD profile, weighted 10 times as much as a climatological profile. Surface to bottom sound speeds were then computed using the UNESCO-87 algorithm (Fofofnoff and Millard, 1983).

Some of the descriptive results from the experiment are described in the next section.

Results

Oceanographic Background

The region of interest for the NEPAC project is primarily the subarctic frontal zone of the Northeast Pacific. In 1989, however, in order to cooperate with the VAST project, the part of the region to be modeled was extended southward into the transition region to the northern limits of the subtropical frontal zone (Fig. 10). The region is a complex one from the physical oceanographic standpoint, with the subarctic region lying north of about 42°N, the subtropical region lying south of about 32°N, and a transition region with multiple fronts and mixed subarctic and subtropical waters lying in between.

The subarctic region is characterized by low temperatures and low salinities (<33.8 psu) in the surface domain, ranging from the upper 30 m in summer to 100 m in winter. Below the surface region is a well defined permanent halocline between 100 and 150 m in which salinity increases from about 33.0 psu to 33.8 psu. Temperature inversions are often found in the halocline, and the southern limit of the subarctic region is that beyond which persistent temperature inversions do not occur. During summer a distinct temperature minimum is located between the bottom of the shallow seasonal thermocline and the underlying temperature

inversion.

The southern limit of the subarctic region is the subarctic front, which is defined by the abrupt change in the salinity structure. The 33.8 ppt isohaline rises from near the base of the subarctic halocline to the surface in the subarctic front. The front extends from the western North Pacific east to North America where it turns southward off California and Baja California and forms what has been called the California Front (Saur, 1980). West of 150°W it generally lies between latitudes 40° - 43°N, and then bends southward east of 150°W. The front consists of not one but several meandering temperature, salinity, and density fronts and their associated eddies, all of which are most pronounced in the upper several hundred meters. Roden and Robinson (1988) review and summarize the properties of the subarctic frontal zone.

The subtropical region lies south of about 32°N, consisting of what Sverdrup (1942) called the North Pacific Central Waters. It is characterized at the surface by salinities greater than 34.8 psu and has a halocline and associated thermocline between about 100 - 250 m in which salinity decreases with depth.

The northern limit of the North Pacific Central Waters is the subtropical front. This front has not been studied as well as the subarctic front, but it appears that the average position of the subtropical front may be defined by the position of the 34.8 or 34.9 psu isohaline at or near the surface (Lynn, 1986). It lies between about 31° - 33°N. Somewhat north of this, around 33°N, is what Lynn (1986) called the northern subtropical front. It appears to originate in the Kuroshio Extension and is continuous or semi-continuous across the North Pacific, and has a temperature range of 14° - 17° (all temperatures are in Celsius) and salinity range of 34.4 - 34.6 psu.

Between the two frontal zones lies the subarctic-subtropical transition zone. It contains waters with both subtropical and subarctic characteristics, mixed in various proportions depending primarily upon the distance from the source regions. Transient temperature inversions between 100 - 200 m are not uncommon in the northern part where the subarctic water is more common.

The figures presented in Appendices A - P will be discussed in light of this oceanographic background. The scales of the figures were chosen to coincide with the figures of the other NOARL Technical Notes which will be coming out in this series.

Horizontal Planes

Horizontal temperature contours at the surface, 25 m, 50 m, 75 m, 100 m, 150 m, 200 m, 250 m, 300 m, 400 m, 500 m, 600 m, and 700 m are presented in Appendices A (Grid 1, 25-28 June 1989), B (Grid 2, 6-7 July 1989) and E (Grid 3, 17-19 July 1989). Appendices C and D contain the same depth levels for the Grid 2 inferred salinity and for sound speed. Preceding each collection of figures is a plot of all drop locations.

The contours at 50 m provide a good example of the features that may be observed in the data. The subarctic front is well defined, with the characteristic presence of several meandering frontal zones and their associated eddies quite apparent. The main portion of the front lies between about 36° - 38° N, with a meander penetrating south between 144° - 148°W. The presence of several eddies is suggested in the meander region, but the sampling was too coarse to properly resolve them. A second but less intense frontal zone lies to the north, with a suggestion (see the Grid 2 temperature and sound speed contours in particular) that the subarctic front bifurcated west of about 143° W into northern and more intense southern filaments. This determination of the region of the subarctic frontal zone is also borne out by the limits of the 8° and 10° isotherms at 150 m (Roden and Robinson, 1988). The southern limit of the subarctic salinity front may be defined by the surfacing of the 33.8 psu isohaline (Roden and Robinson, 1988), and on the inferred surface salinity plot for Grid 2, this lies in the southern portion of the frontal zone as defined by the 8° and 10° isotherms. There is some evidence from the three grids that over the three weeks of the

experiment, the meander pushed further south and pinched off into an eddy (see, for example, the volution at 50 m of the 15° isotherm in the meander over the three grid resolutions).

The second front which is visible in the data, between 34° - 36°N, may be a northward meander of the northern subtropical front. Its position agrees quite closely with Lynn's (1987) observations except that the temperature range of the frontal region is about 18° - 20° rather than the 14° - 17° quoted above.

Vertical Transects

Temperature contours along the vertical transects flown during each of the three grids are plotted from the surface to 300 m in Appendices F, H, and M. In addition, temperature extended to the bottom, inferred salinity and calculated sound speed are plotted from the surface to 5500 m for the second grid in Appendices I, J, and K. Preceding each collection of figures is a plot of all drop positions, annotated with the transect numbers which appear in the figure labels.

Flights around the boundary of the region in which the tactical scale modeling was emphasized were conducted between Grids 1 and 2 and Grids 2 and 3. Temperature contours from 0 - 300 m are plotted for all four sides of each boundary flight in Appendices G and L.

GEOSAT Tracks

Temperature contours from surface - 300 m and surface - 5500 m from each of the three GEOSAT underflights are presented in Appendices N, O, and P, along with the inferred salinity and calculated sound speed from the surface to 5500 m. Drop positions are plotted on the charts preceding each collection of transects.

In all six GEOSAT lines, centered around 40 m is a strong seasonal thermocline to the north of about 37°N. The thermocline region seems to bifurcate south of 37°, with a less intense thermocline continuing at 40 m and a rapid descent of another portion of the thermocline down to greater than 100 m. Signatures of the subarctic and northern subtropical (?) fronts may be observed around 37°N and 34°N on most of the transects.

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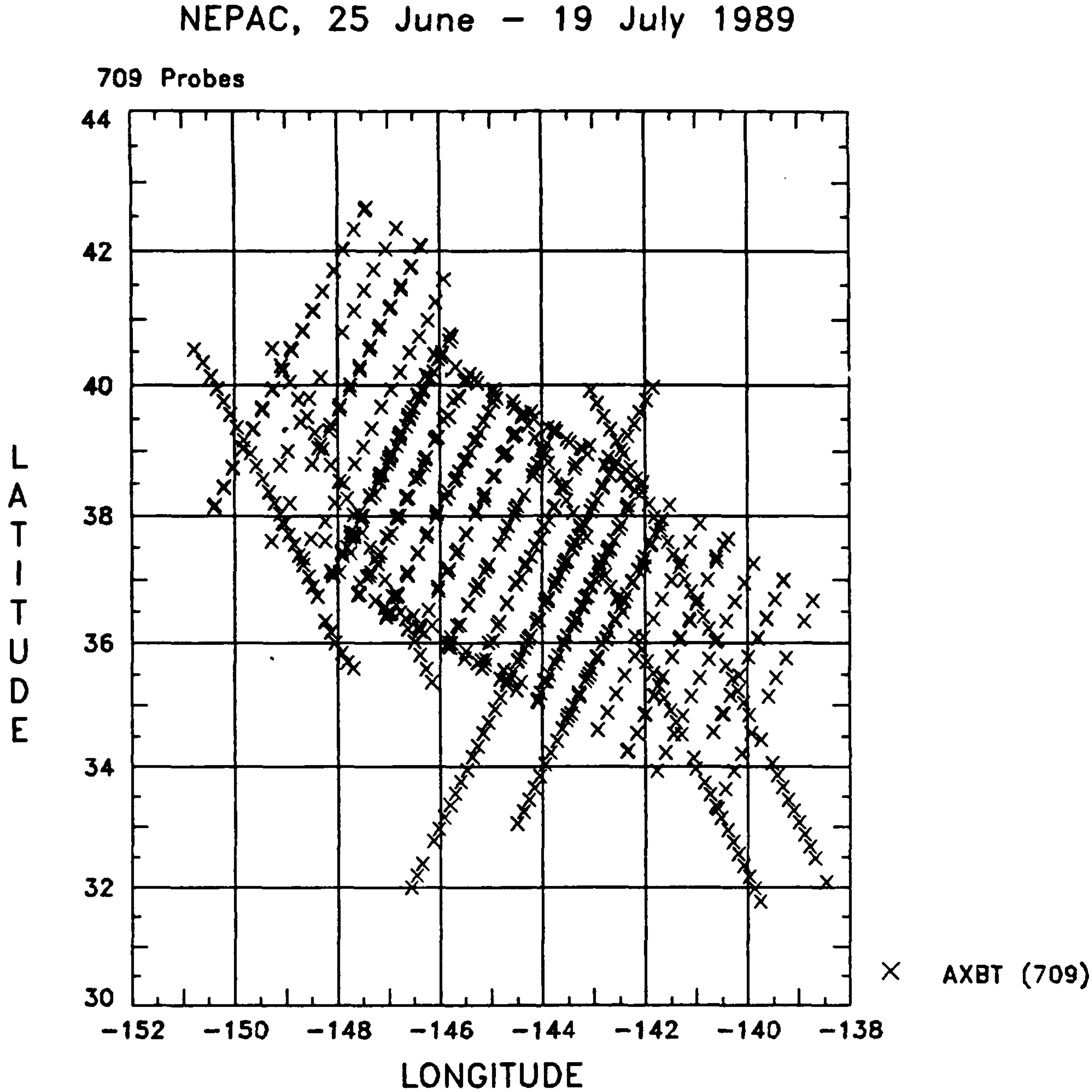


Figure 1. Composite of all NEPAC drop positions between 25 June - 19 July 1989.

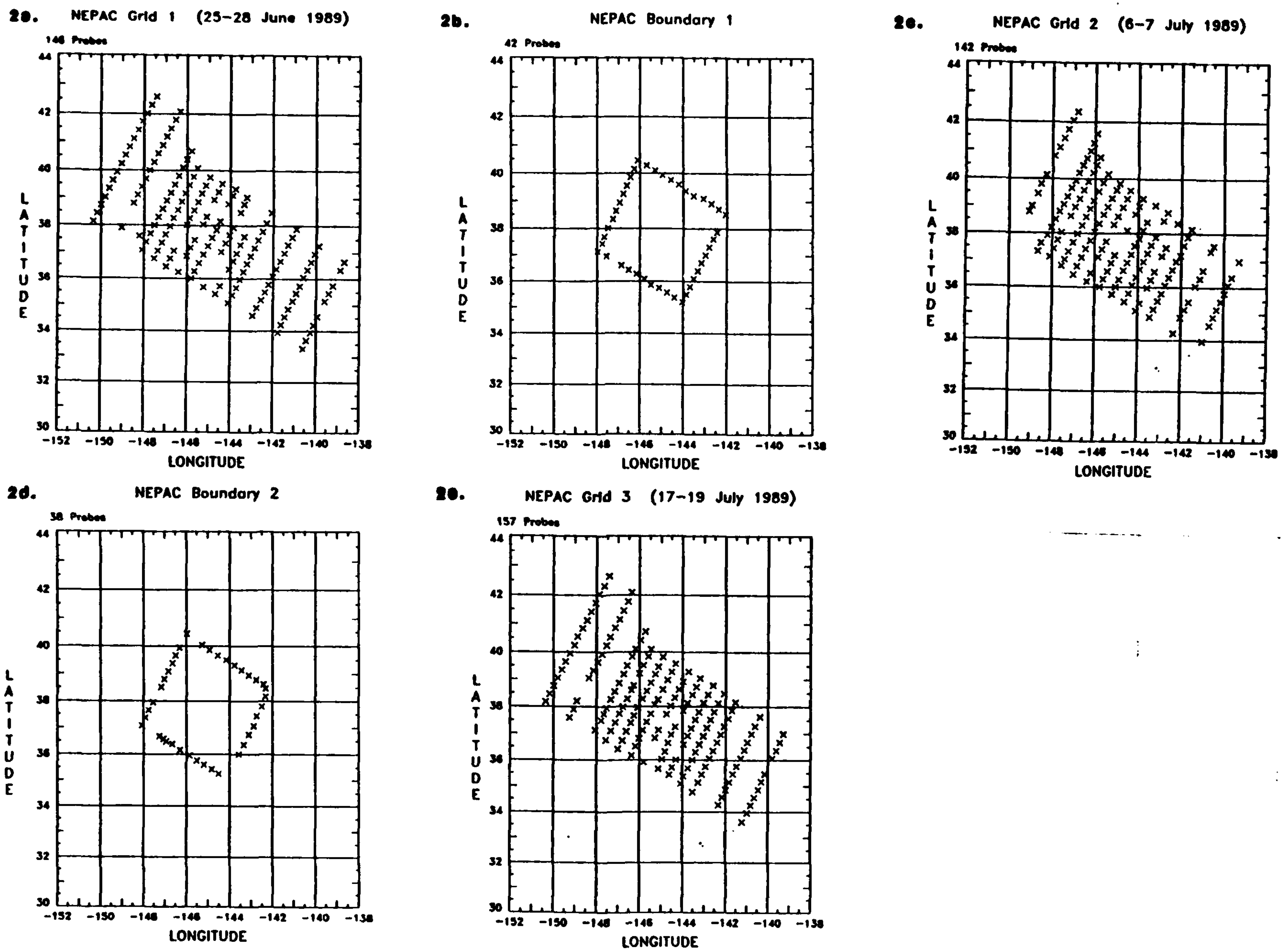


Figure 2. The three individual NEPAC grids (a, c, e) and the two boundary flights (b, d).

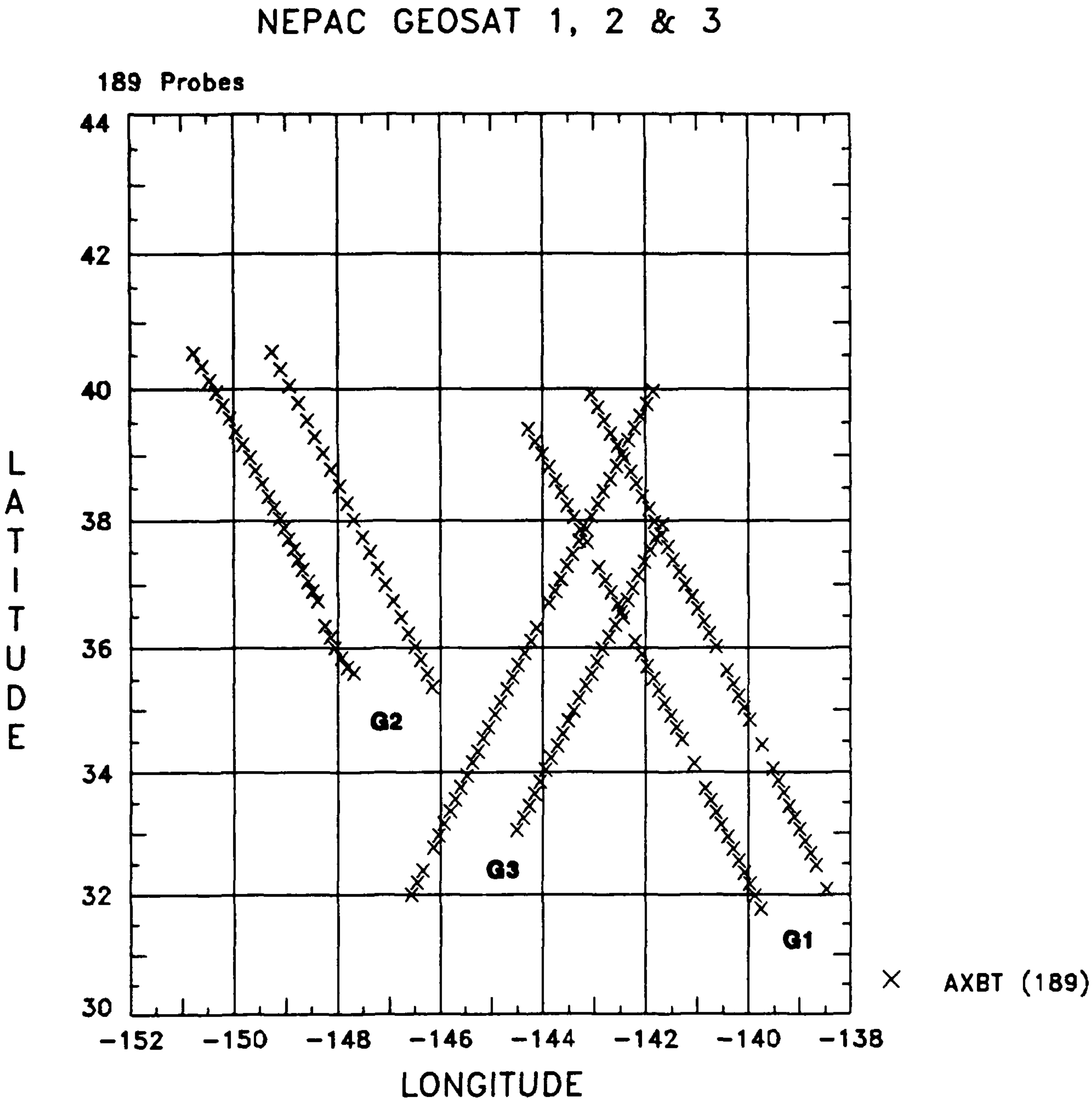


Figure 3. The three sets of NEPAC GEOSAT tracks.

ISIS ACQUISITION, PROCESSING, AND ANALYSIS SYSTEM

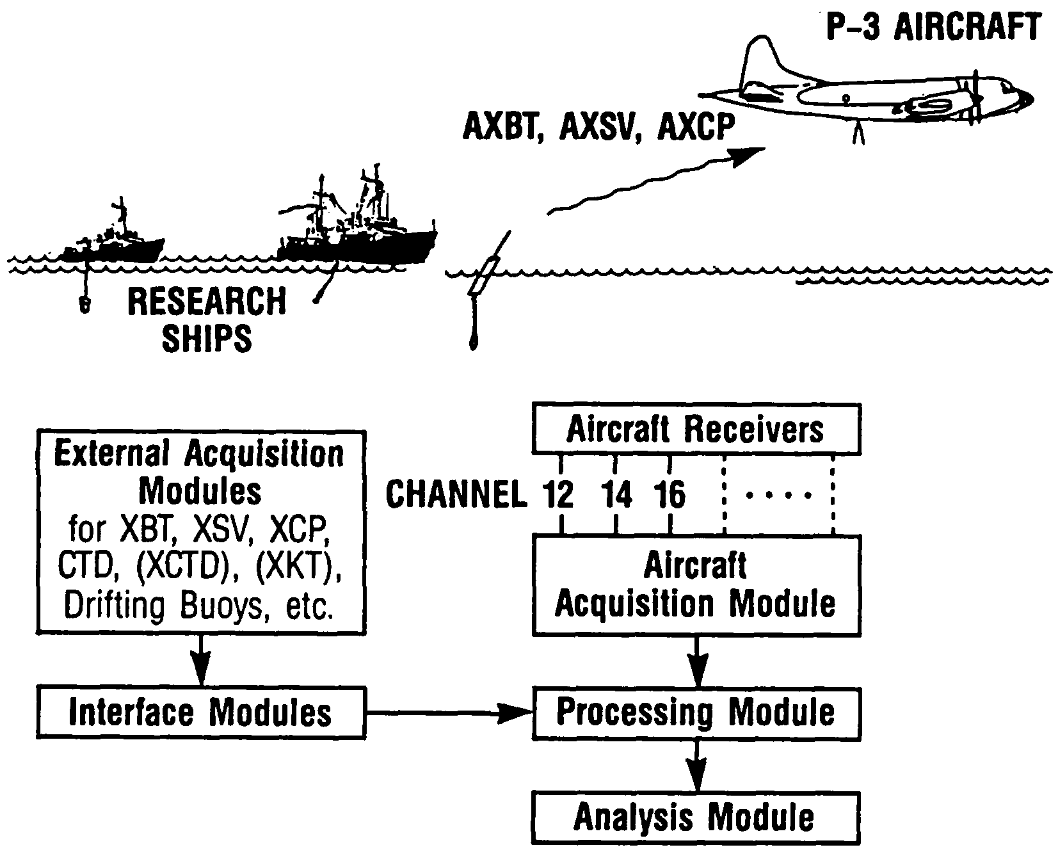


Figure 4. Outline of the Isis acquisition, processing, and analysis system.

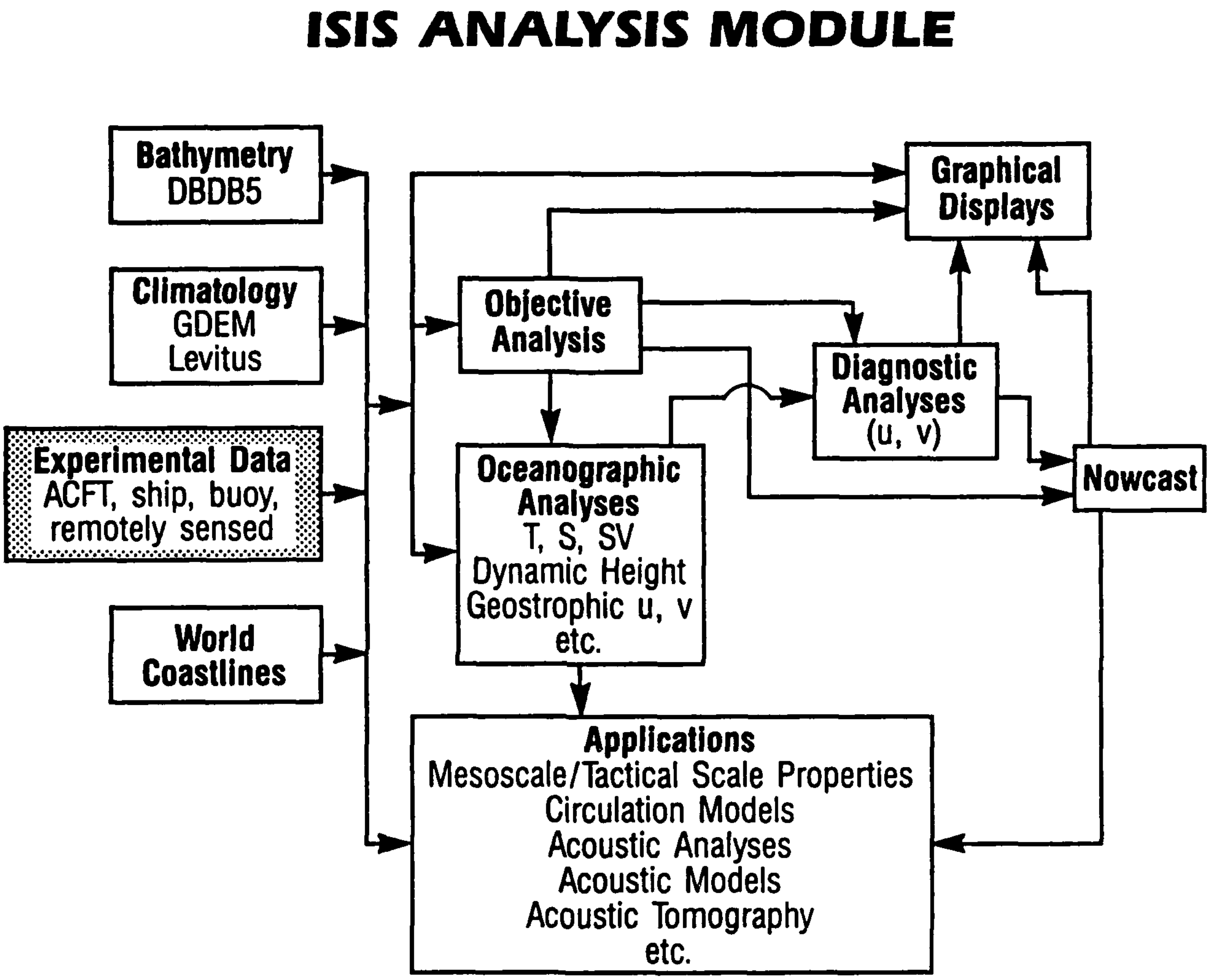


Figure 5. Isis system capabilities.

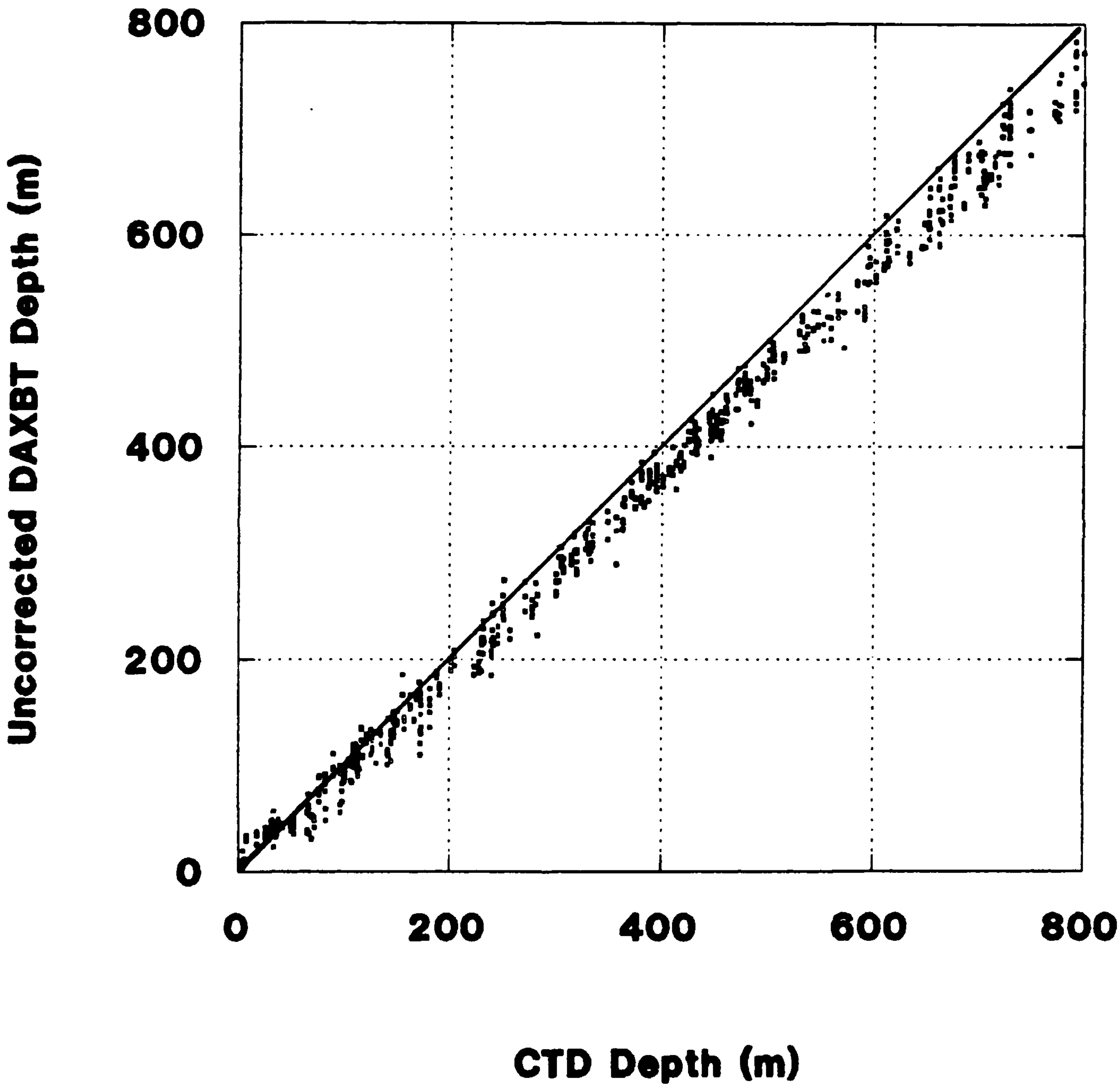


Figure 6. Uncorrected deep AXBT (DAXBT) isotherm depths versus CTD isotherm depths.

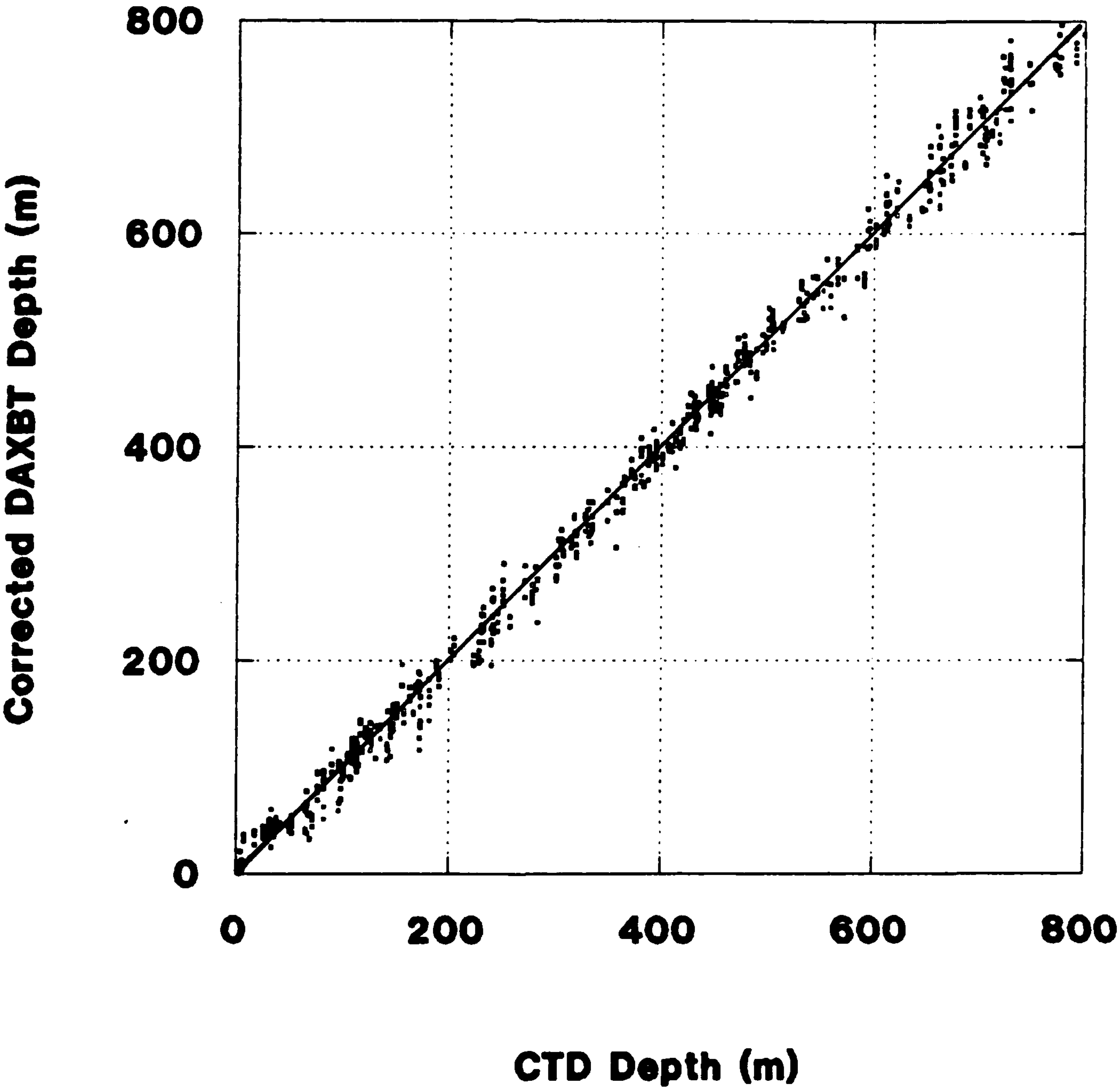


Figure 7. Corrected deep AXBT (DAXBT) isotherm depths versus CTD isotherm depths.

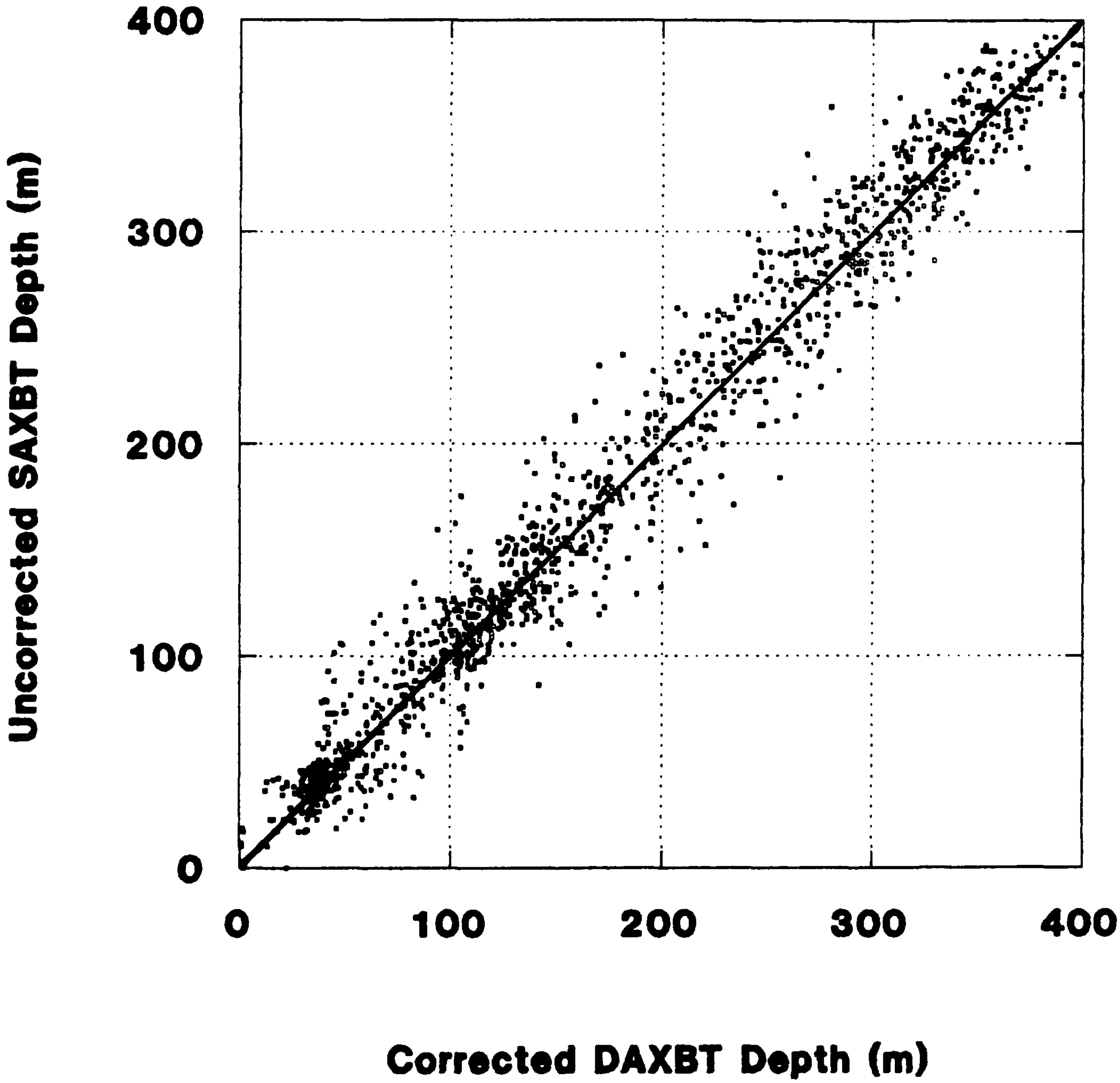


Figure 8. Uncorrected shallow AXBT (SAXBT) isotherm depths versus corrected deep AXBT (DAXBT) isotherm depths.

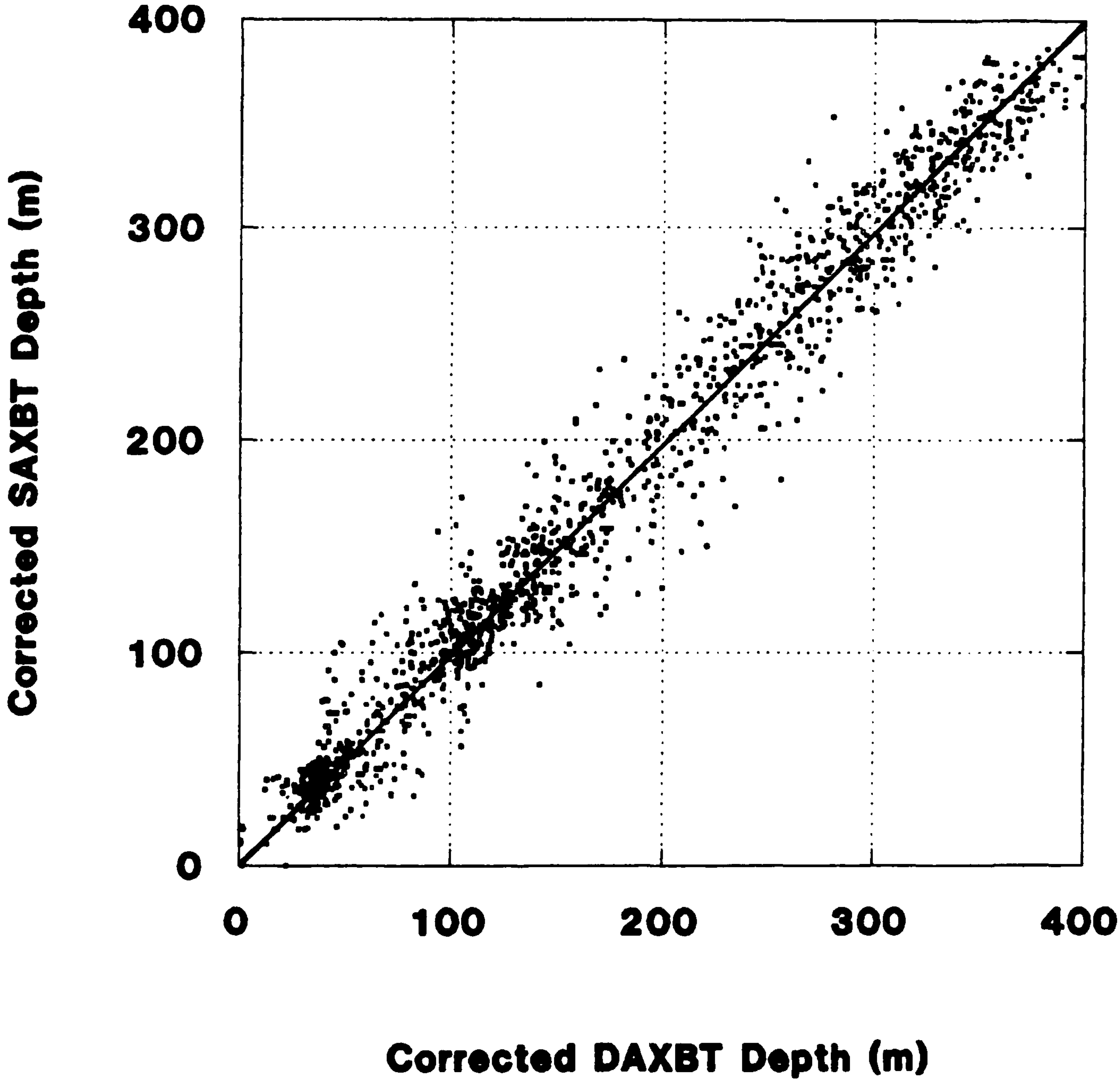


Figure 9. Corrected shallow AXBT (SAXBT) isotherm depths versus corrected deep AXBT (DAXBT) isotherm depths.

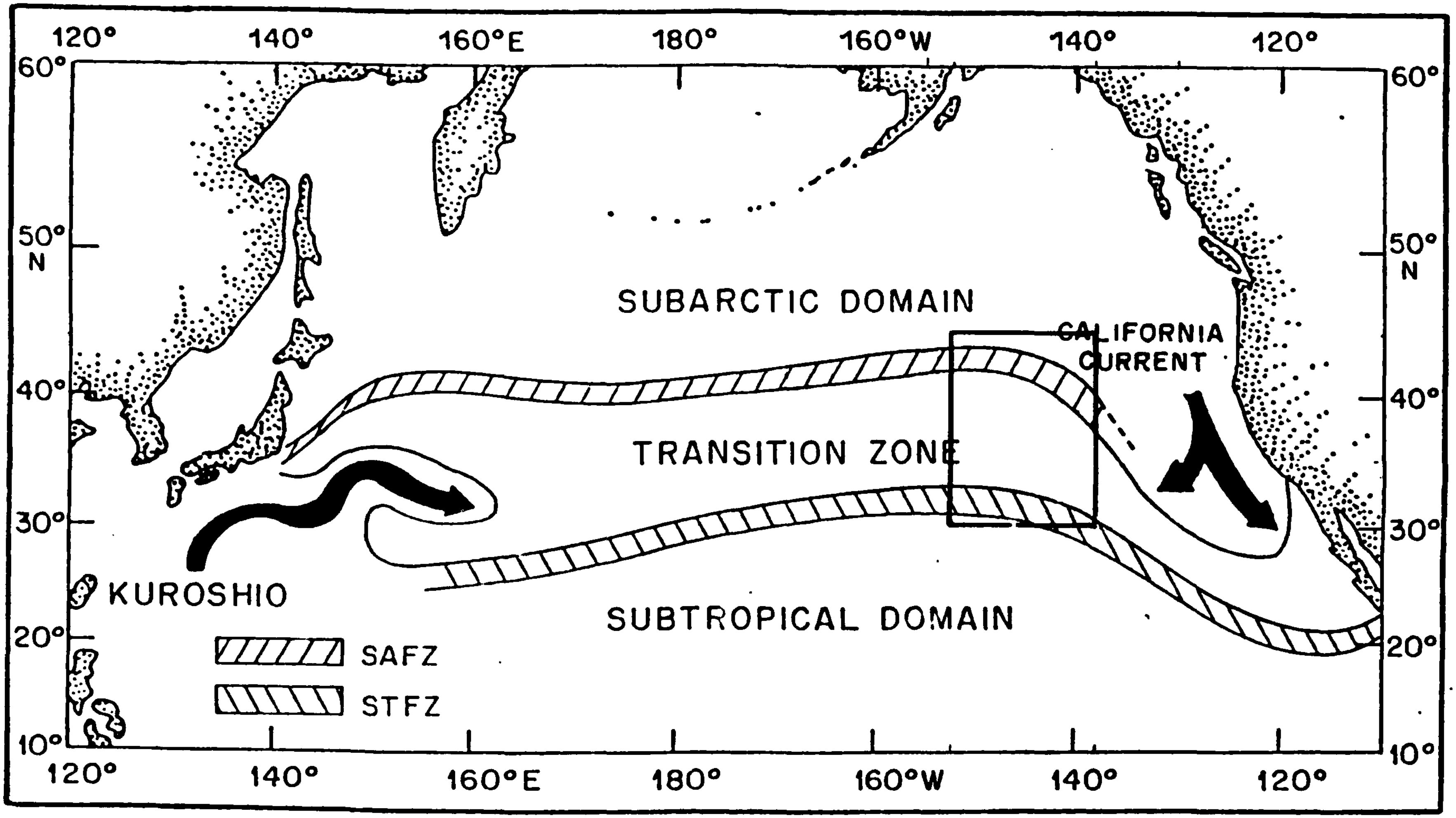


Figure 10. Schematic view of the principal oceanic regions in the mid-latitude North Pacific. Arrows indicate prevailing current directions. SAFZ is subarctic salinity frontal zone; STFZ is the subtropical temperature frontal zone. The NEPAC area during June - July 1989 is shown by the box. (From Roden and Robinson, 1989).

Appendix A.

NEPAC Grid 1 (25 - 28 June 1989)

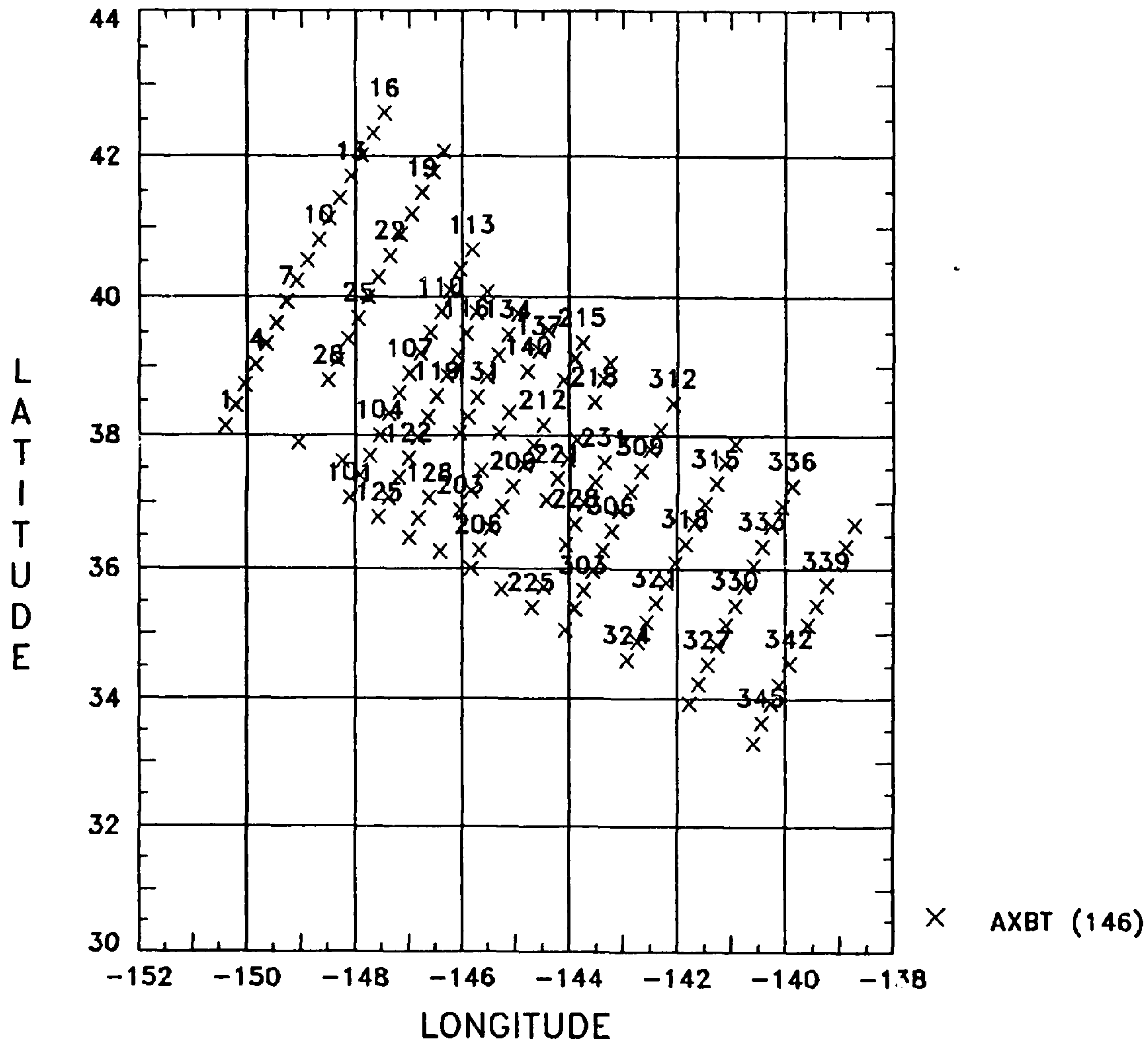
Temperature Contours at Selected Depths

9:05:57

5/09/90

NEPAC Grid 1 (25–28 June 1989)

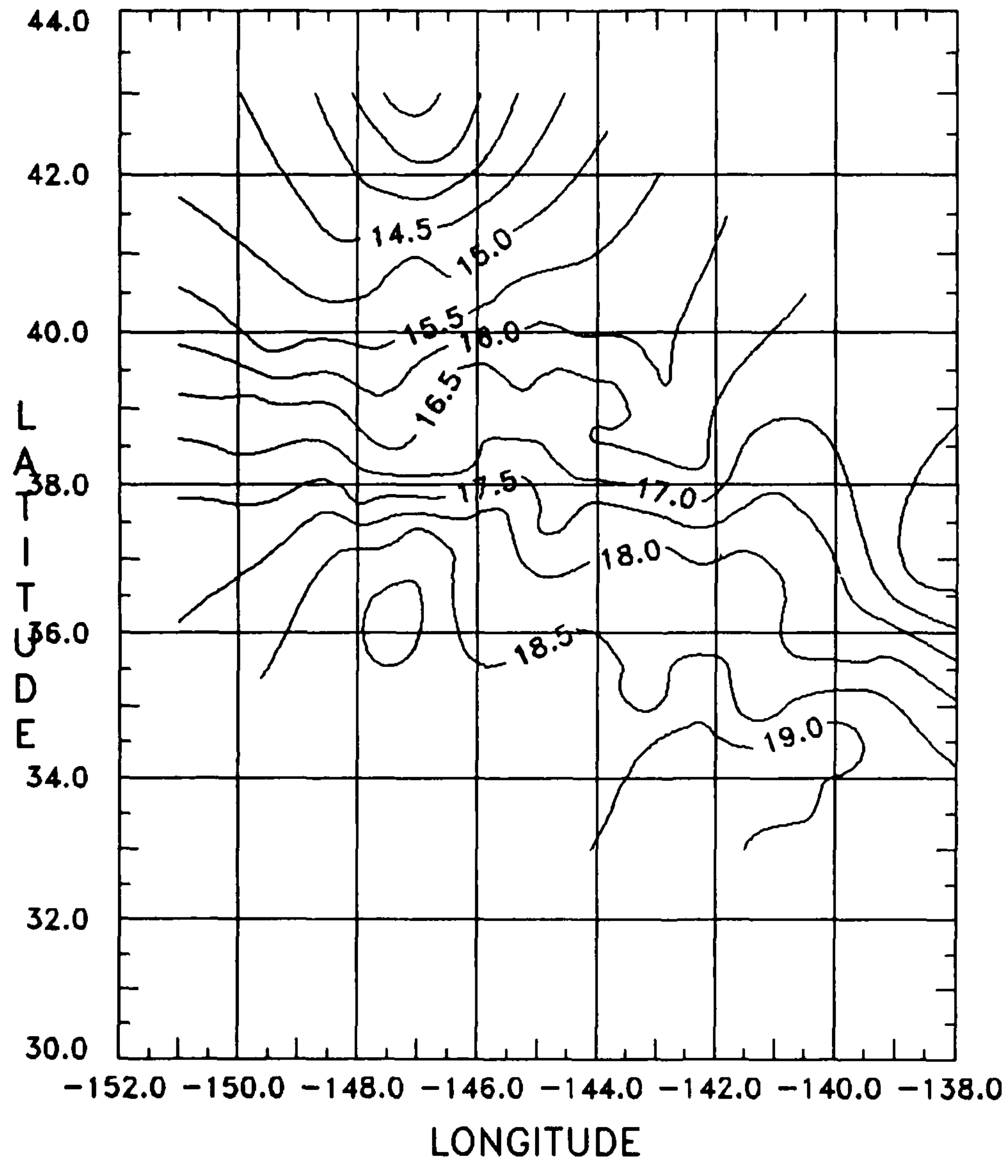
146 Probes



NOARL Code 331

NEPAC Grid 1 (25–28 June 1989)

0 METERS TEMPERATURE (DEG C)



NOARL Code 331

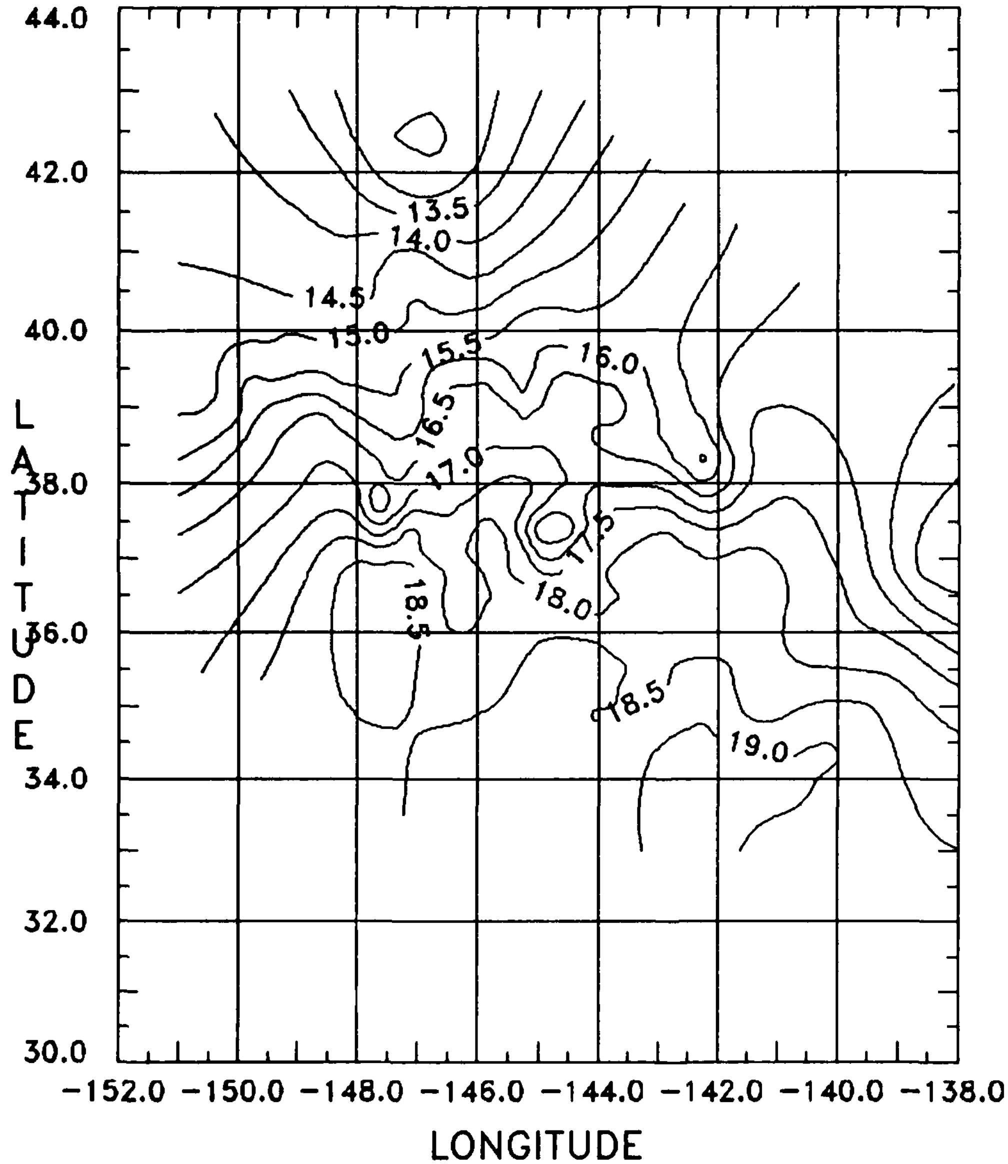
dx=.3 ,dy=.3

11/27/89

15:18:44

NEPAC Grid 1 (25–28 June 1989)

25 METERS TEMPERATURE (DEG C)



NOARL Code 331

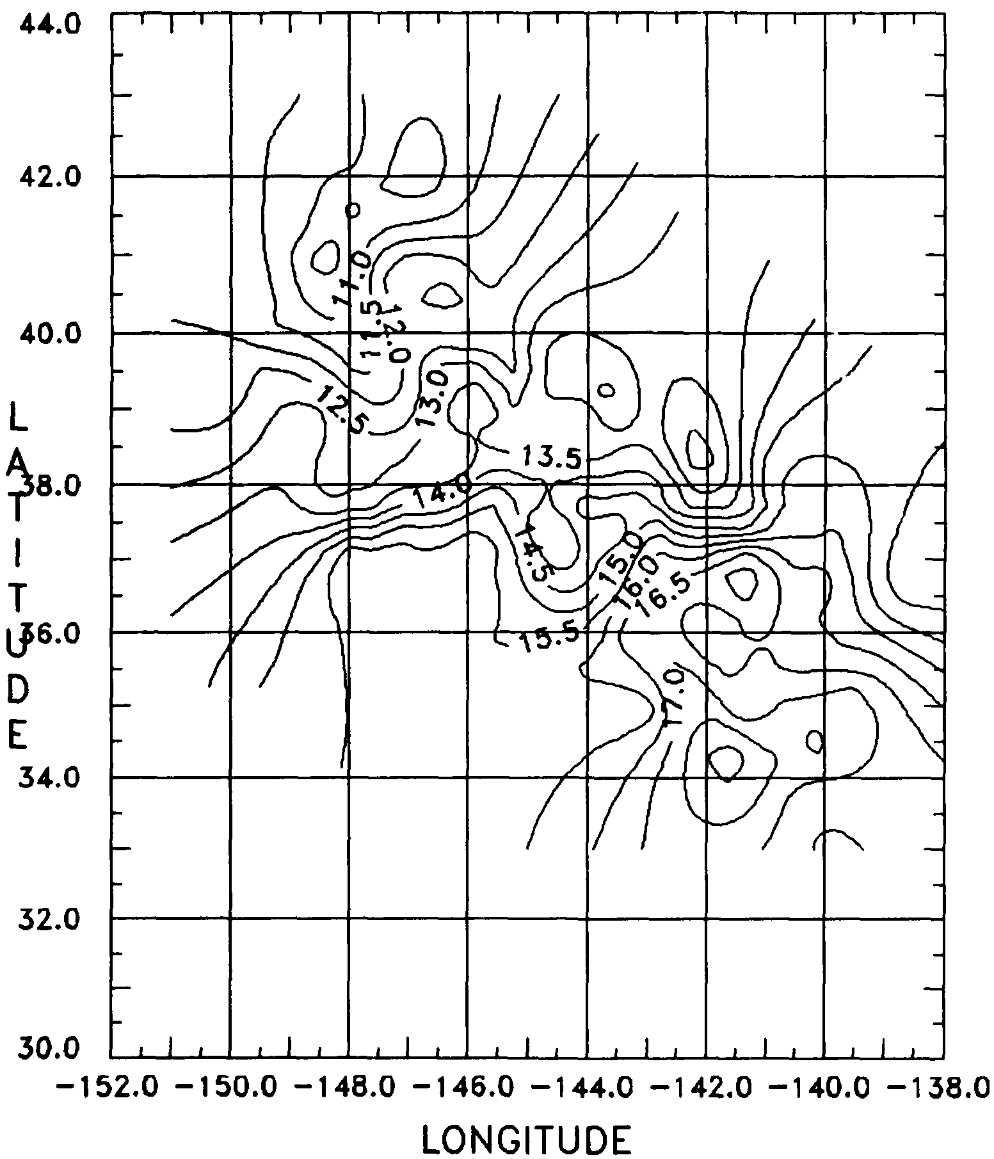
15:19:55

11/27/89

dx=.3 ,dy=.3

NEPAC Grid 1 (25–28 June 1989)

50 METERS TEMPERATURE (DEG C)

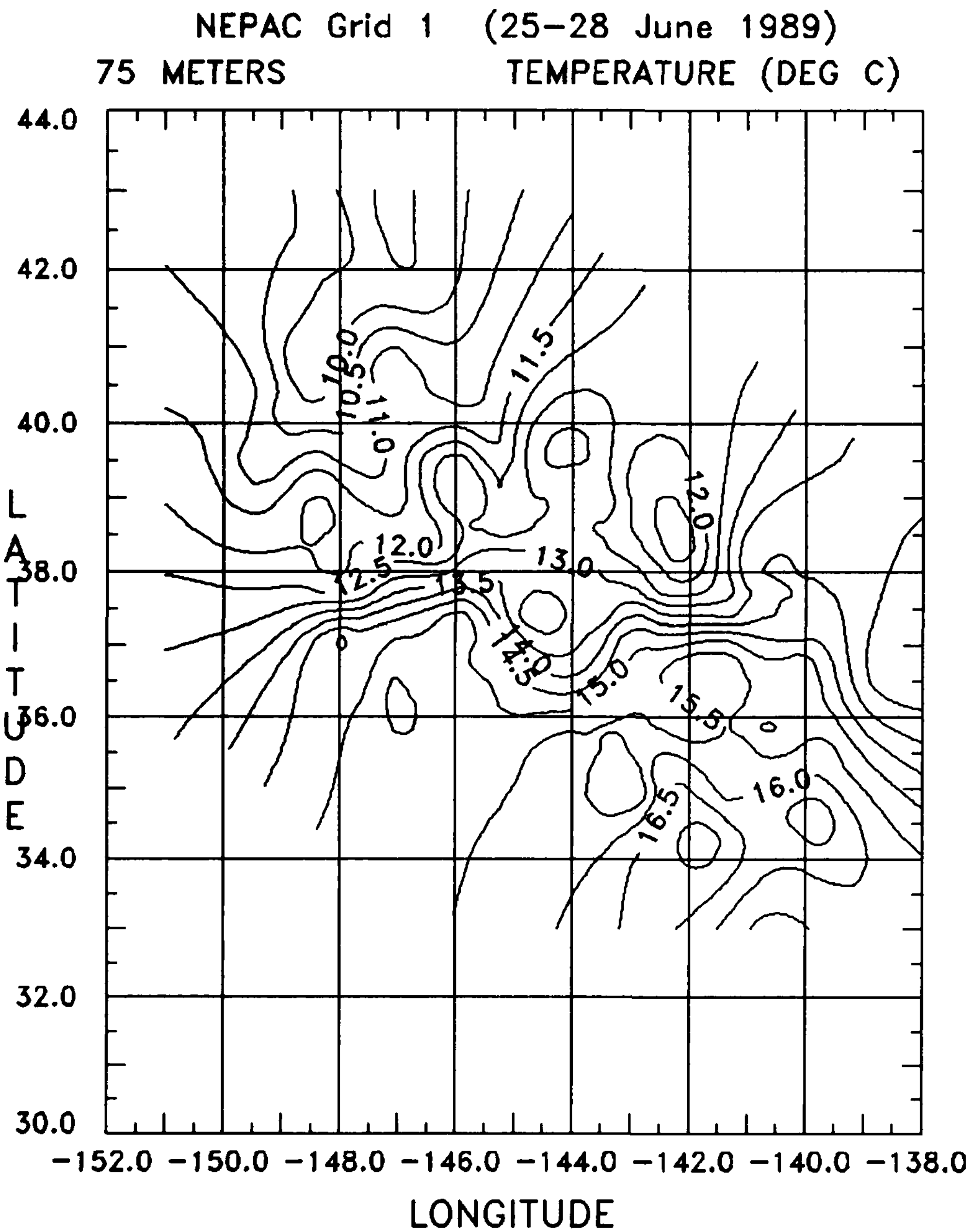


NOARL Code 331

15:21:11

11/27/89

dx=.3 ,dy=.3



NOARL Code 331

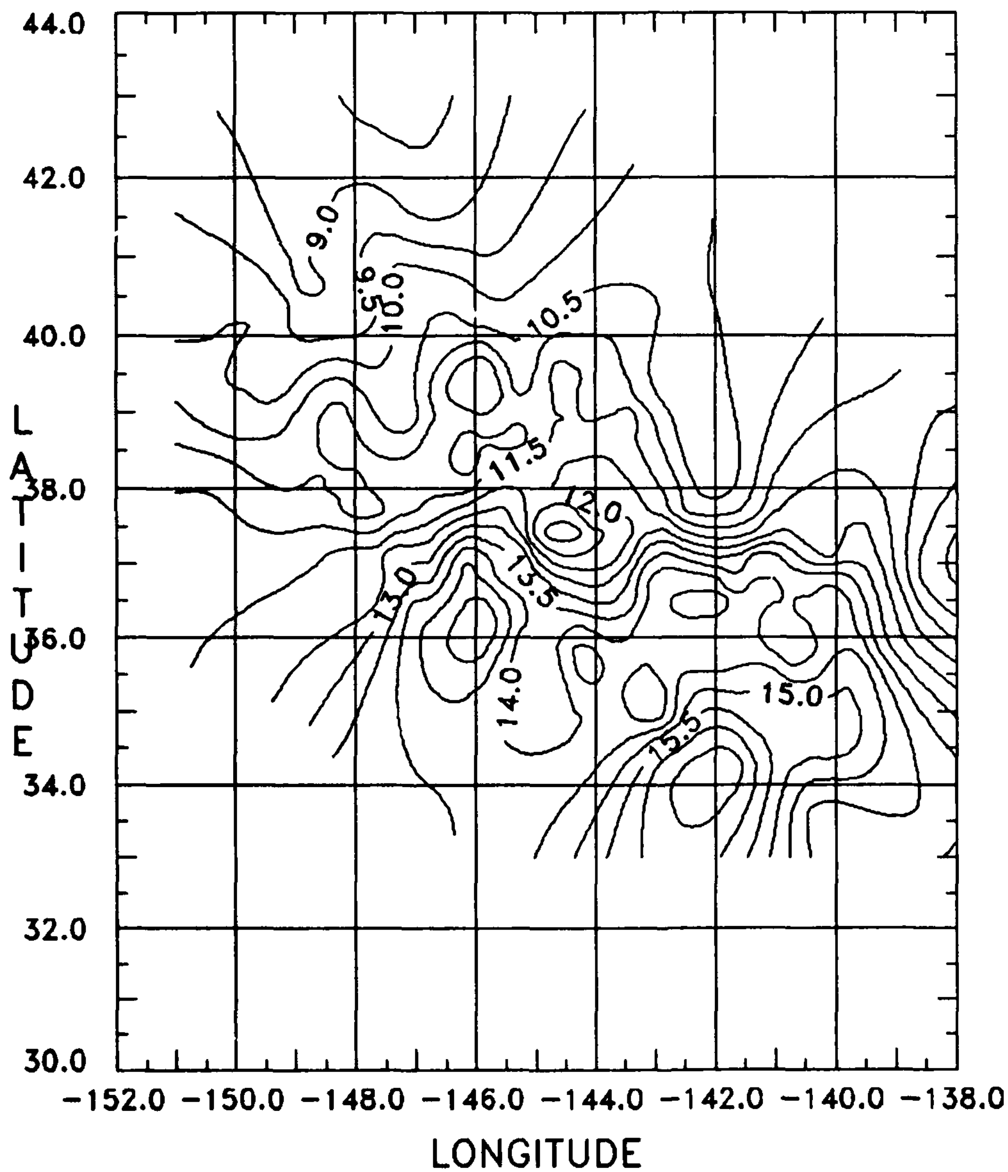
15:22:31

11/27/89

dx=.3 ,dy=.3

NEPAC Grid 1 (25–28 June 1989)

100 METERS TEMPERATURE (DEG C)

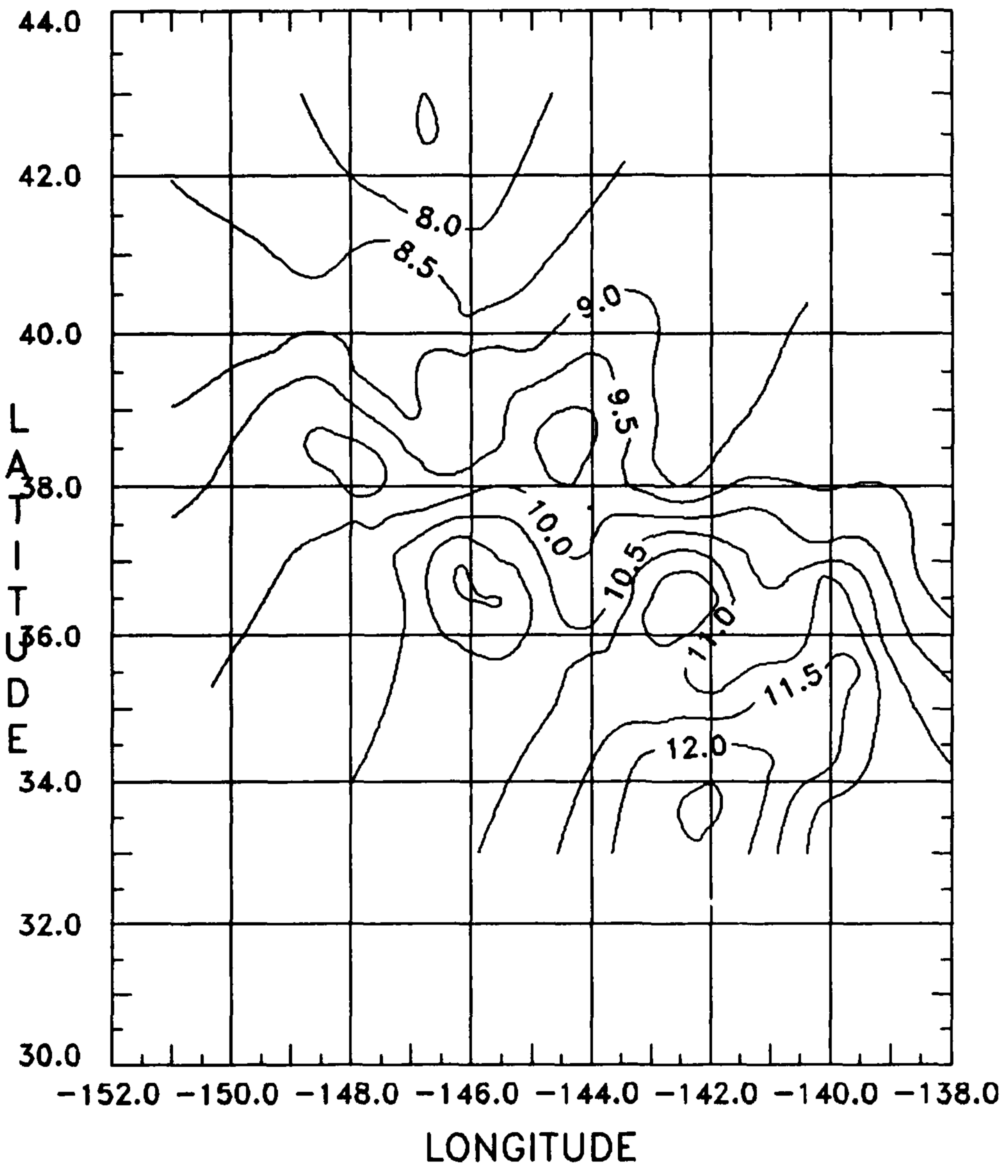


NOARL Code 331

15:24:05 11/27/89 dx=.3 ,dy=.3

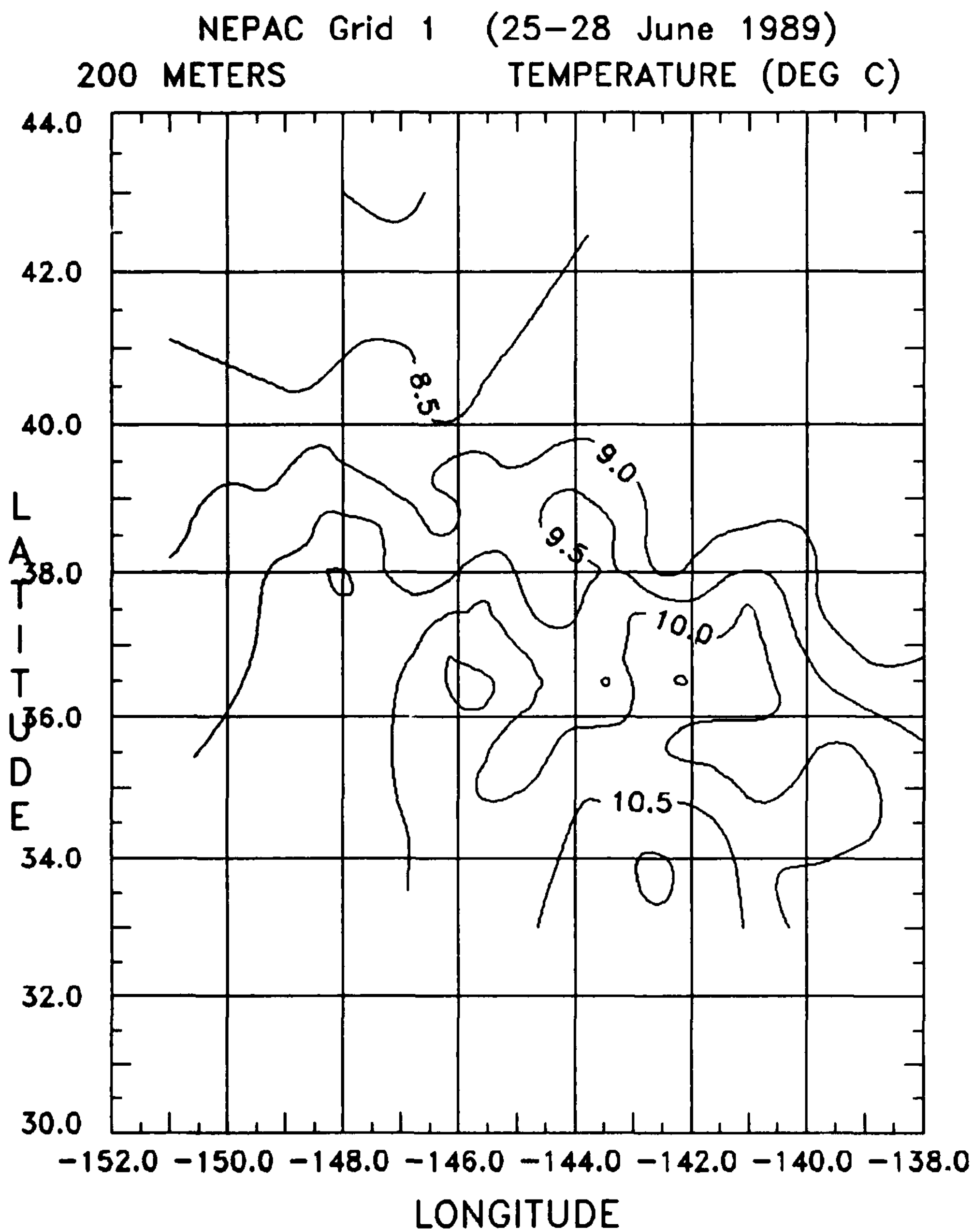
NEPAC Grid 1 (25–28 June 1989)

150 METERS TEMPERATURE (DEG C)



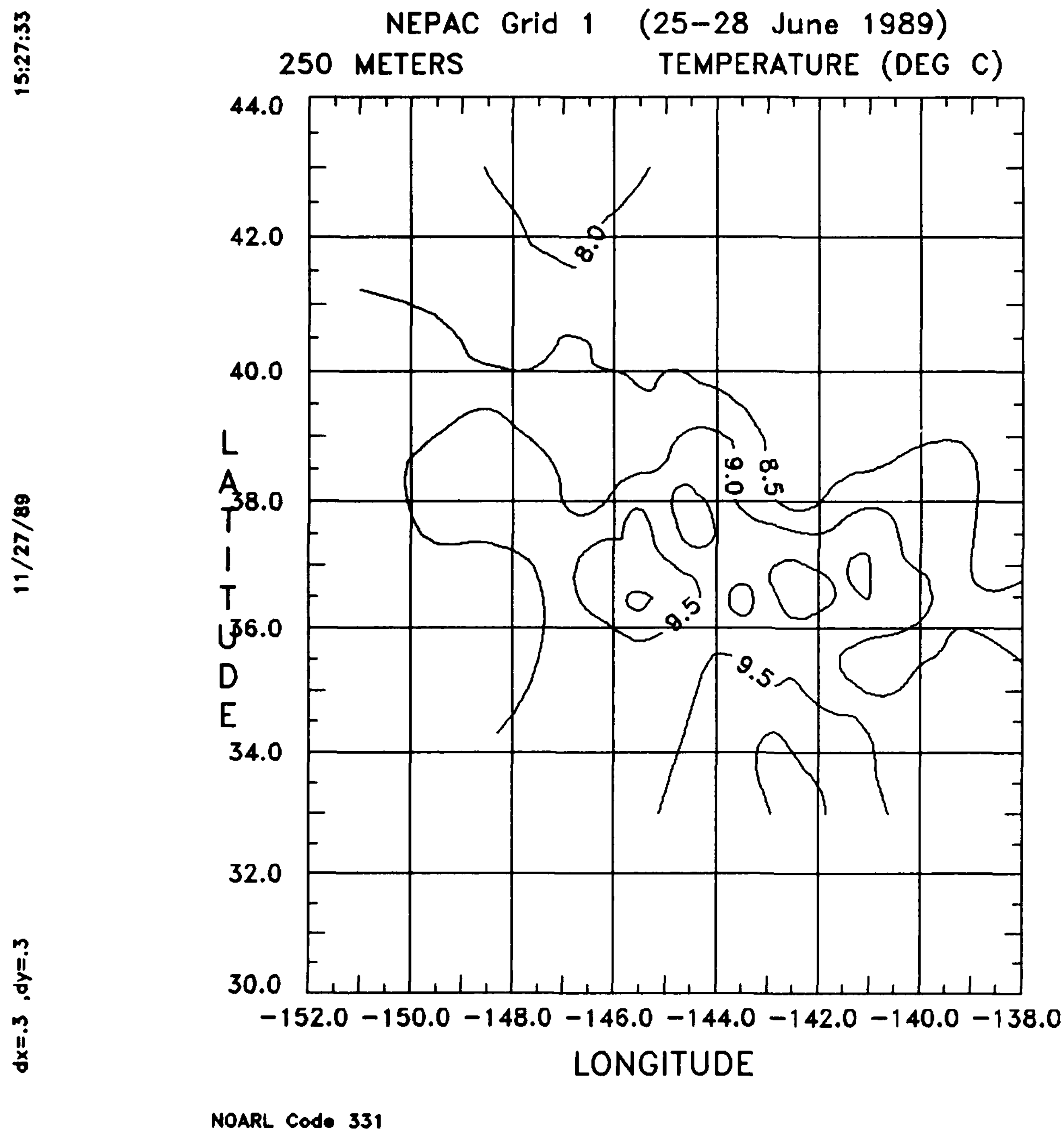
NOARL Code 331

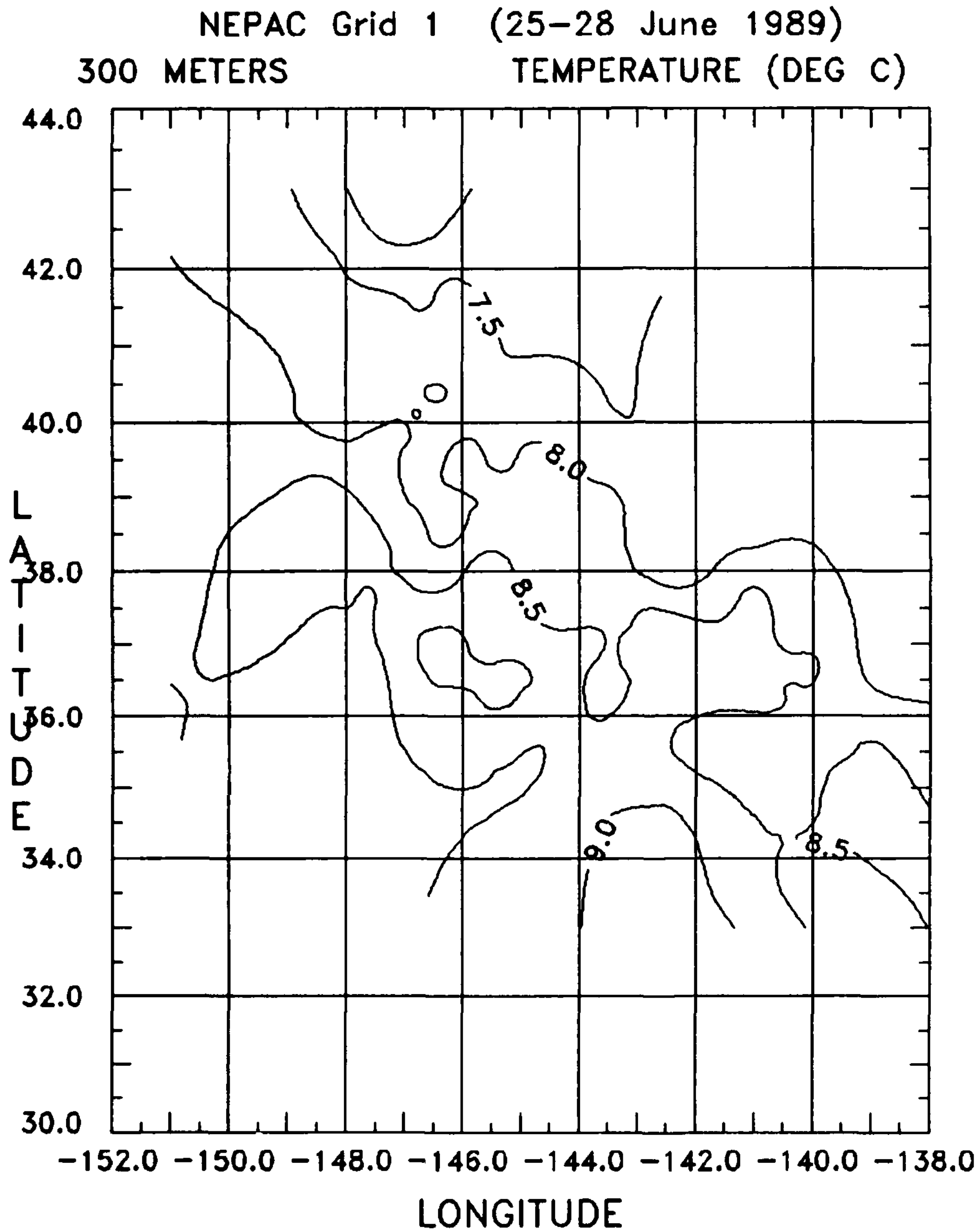
15:25:29 11/27/89 dx=.3 ,dy=.3



NOARL Code 331

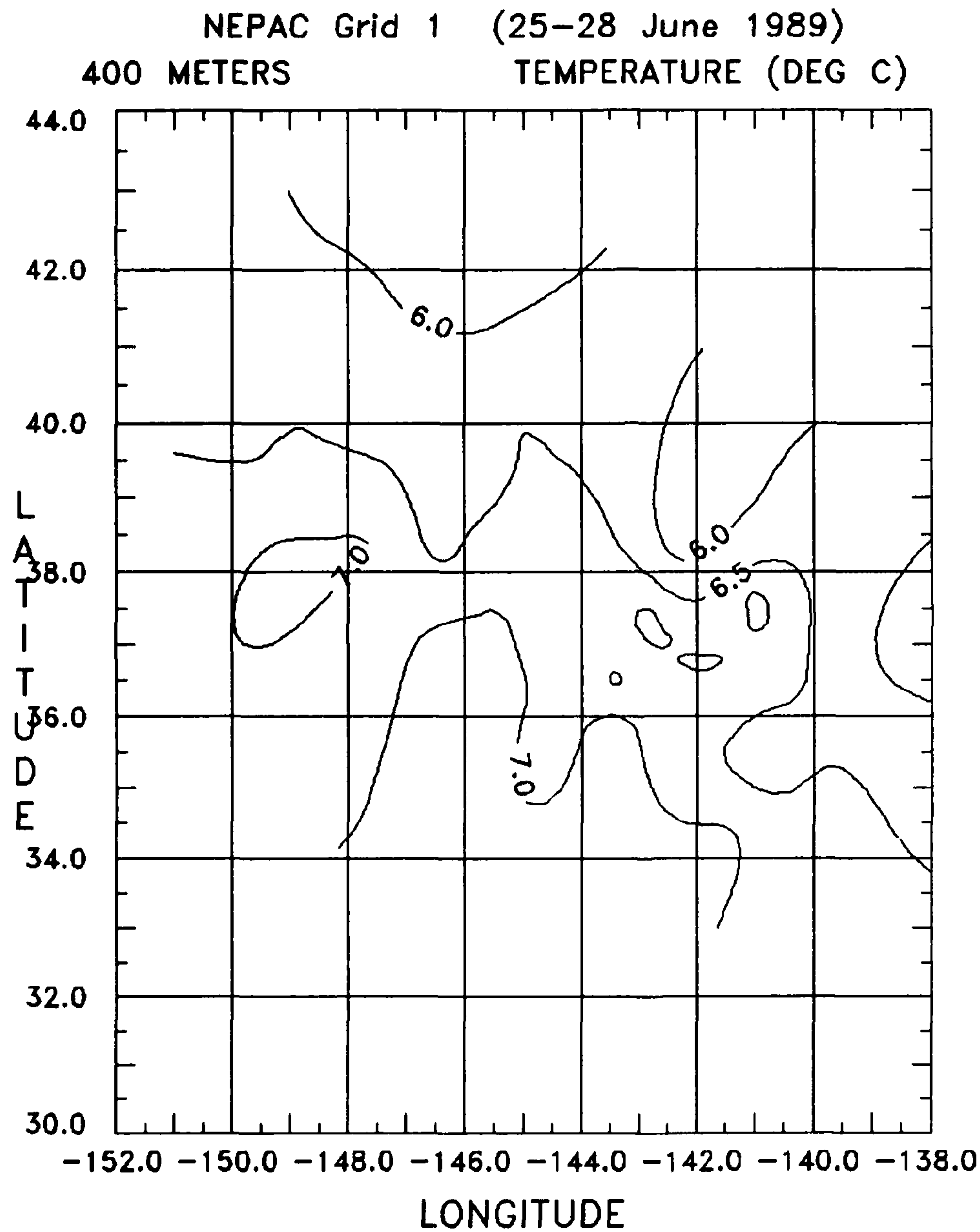
15:26:34 11/27/89 dx=.3 ,dy=.3


NEPAC Grid 1 (25–28 June 1989)
250 METERS
TEMPERATURE (DEG C)
44.0
42.0
40.0
38.0
36.0
34.0
32.0
30.0
LATITUDE
−152.0 −150.0 −148.0 −146.0 −144.0 −142.0 −140.0 −138.0
LONGITUDE
8.0
8.5
9.0
9.5
9.5
15:27:53
11/27/89
dx=.3 ,dy=.3
NOARL Code 331



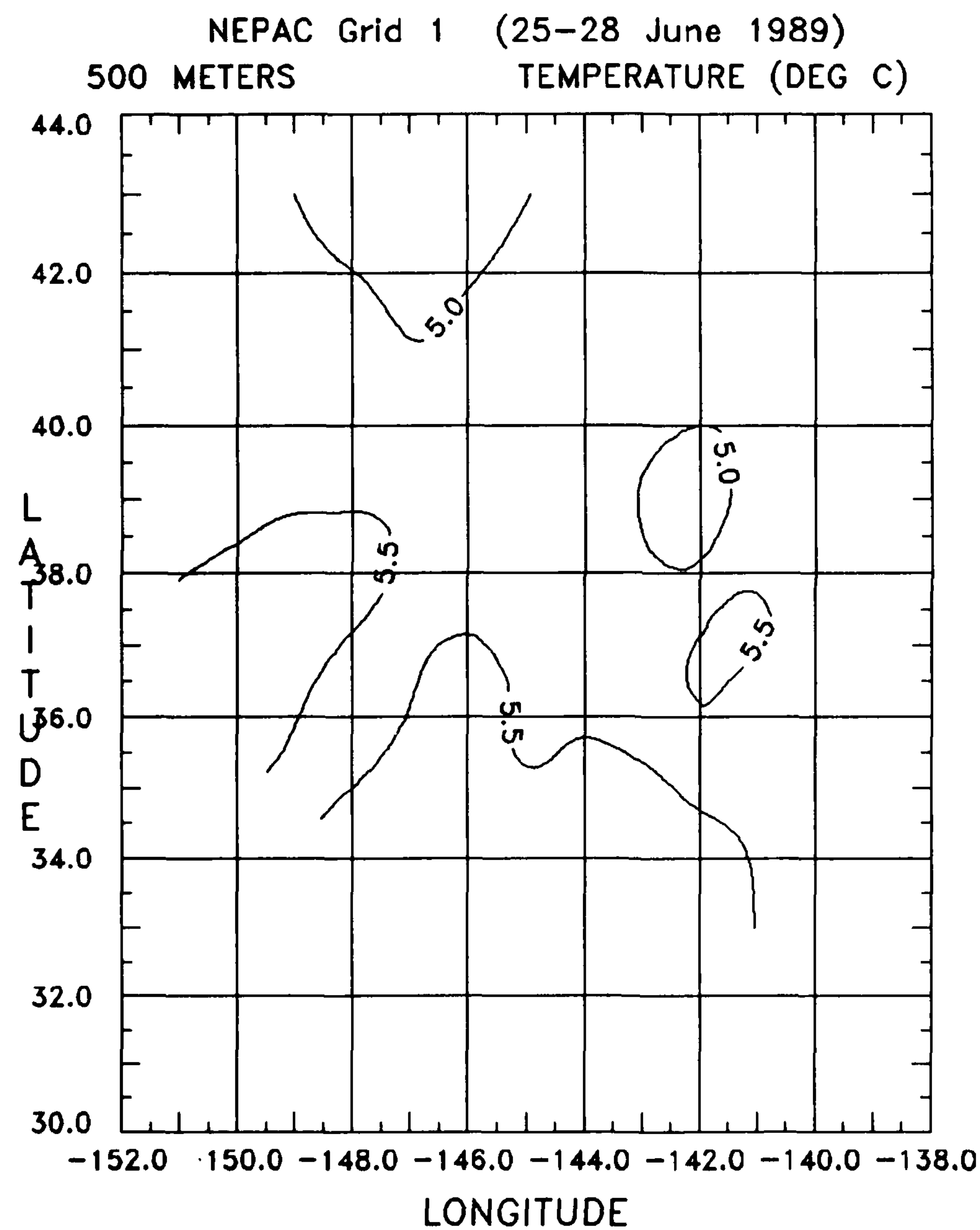
NOARL Code 331

15:28:31 11/27/89 dx=.3 ,dy=.3



NOARL Code 331

15:29:41 11/27/89 dx=.3 ,dy=.3

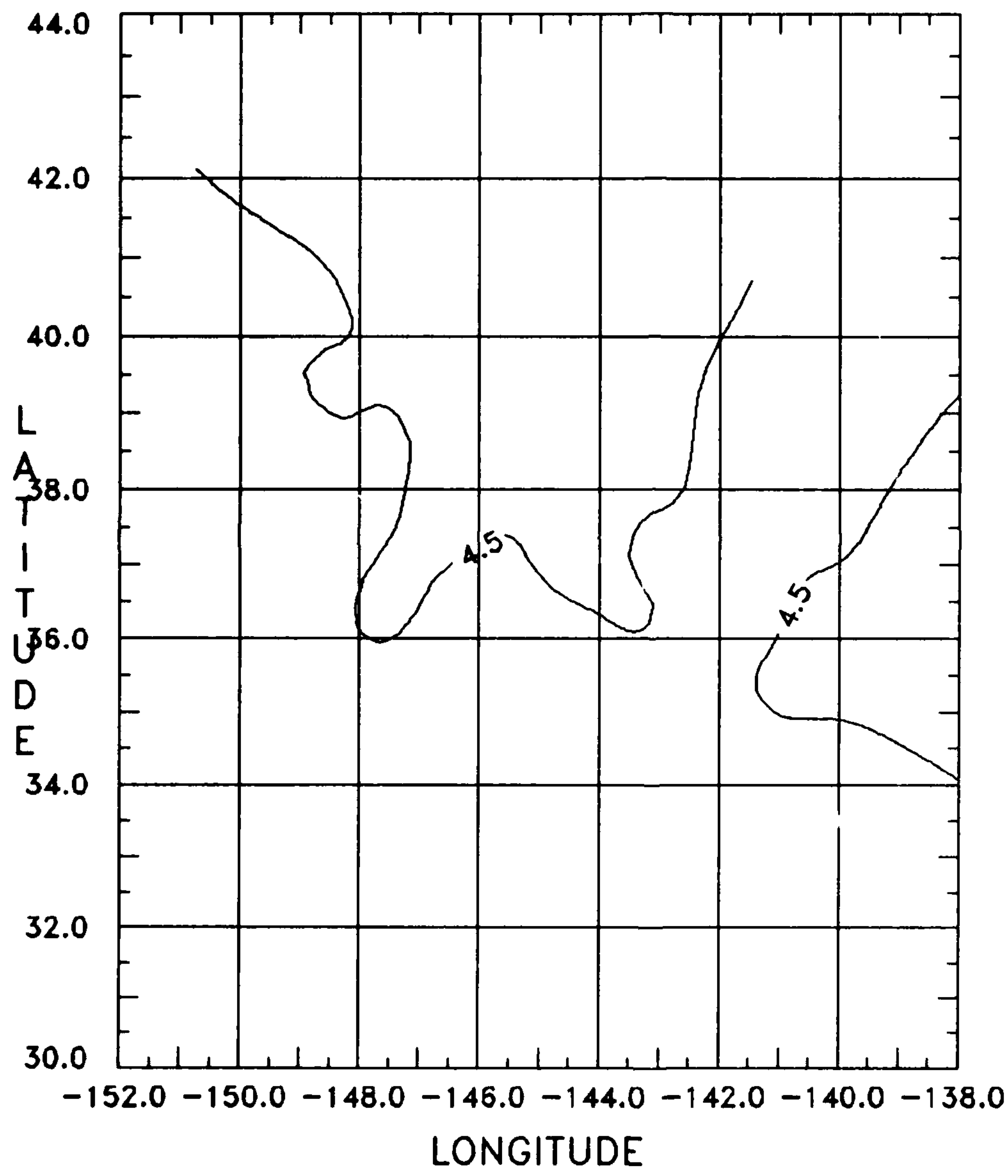


NOARL Code 331

15:30:53 11/27/89 dx=.3 ,dy=.3

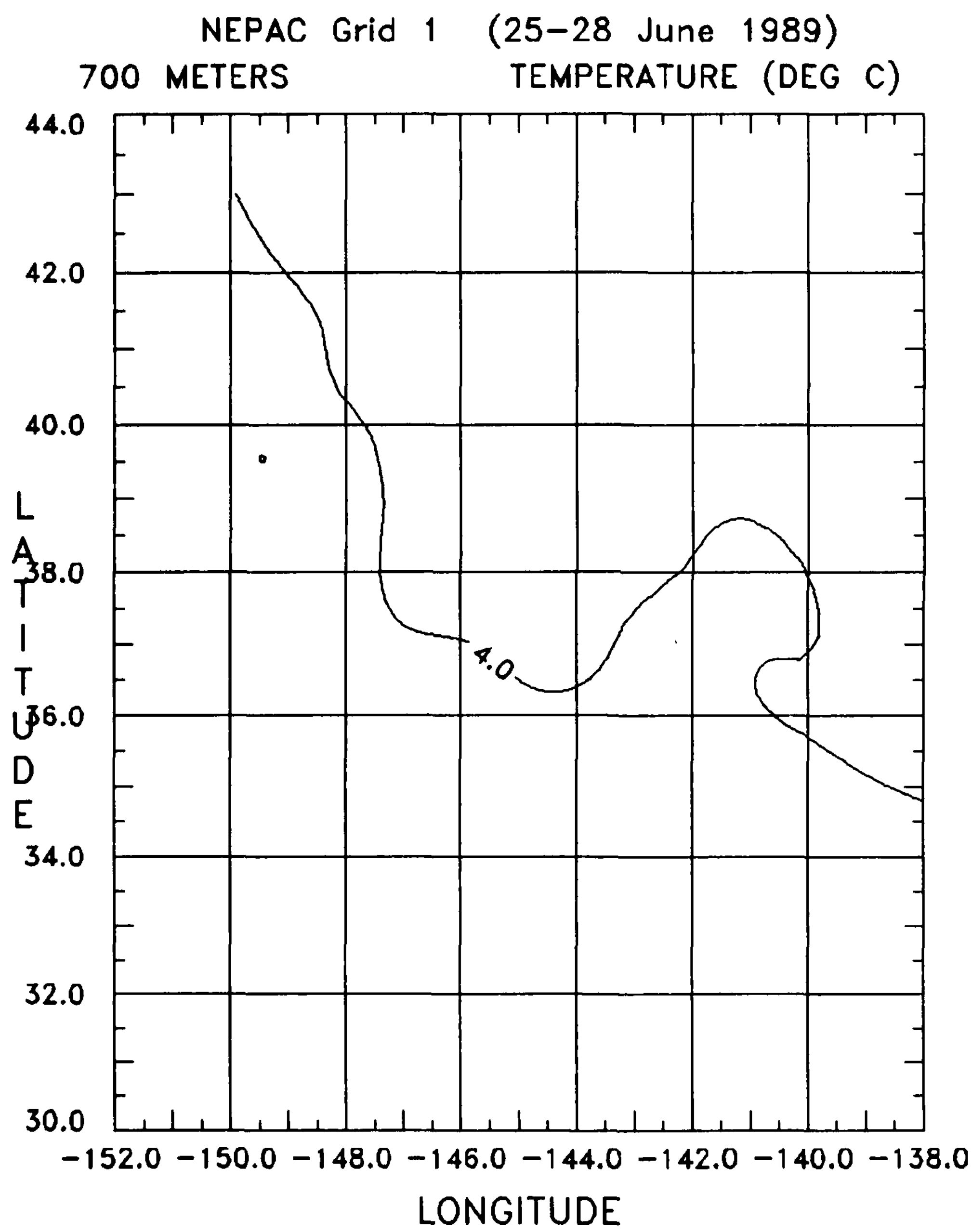
NEPAC Grid 1 (25–28 June 1989)

600 METERS TEMPERATURE (DEG C)



NOARL Code 331

15:31:21 11/27/89 dx=.3 ,dy=.3



NOARL Code 331

15:32:08 11/27/89 dx=.3 ,dy=.3

Appendix B.

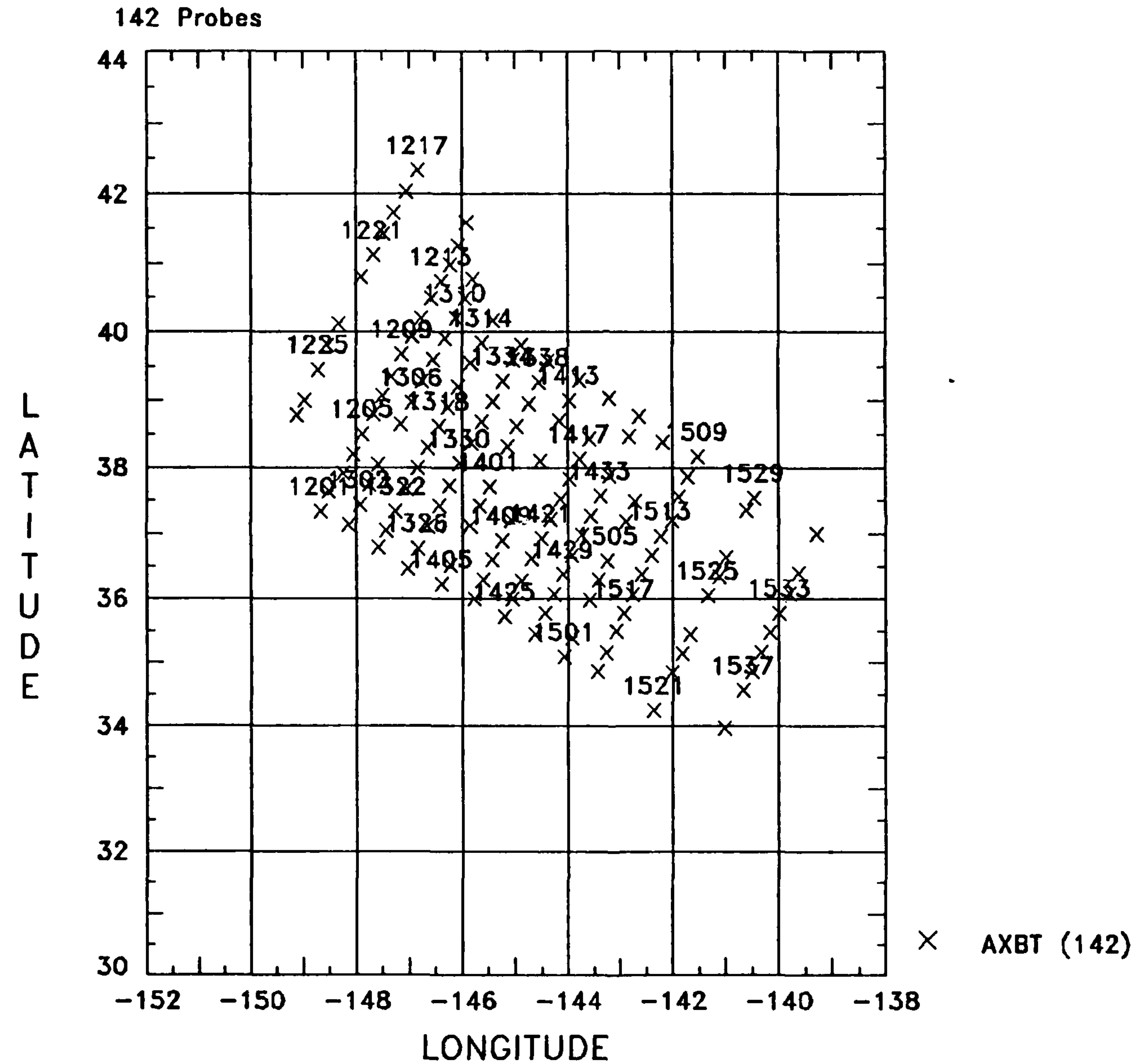
NEPAC Grid 2 (6 - 7 July 1989)

Temperature Contours at Selected Depths

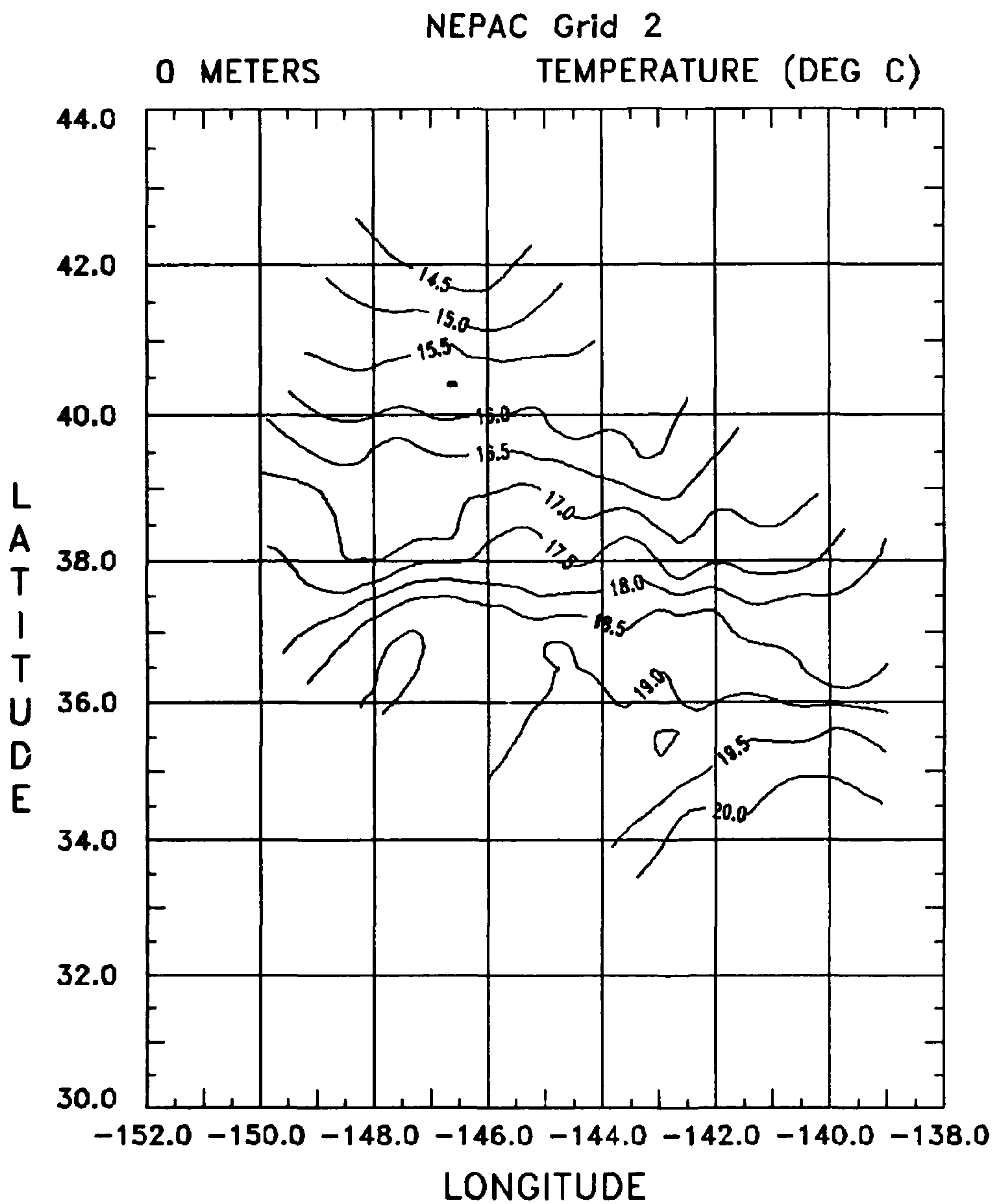
8:55:51

5/09/90

NEPAC Grid 2 (6–7 July 1989)



NOARL Code 331

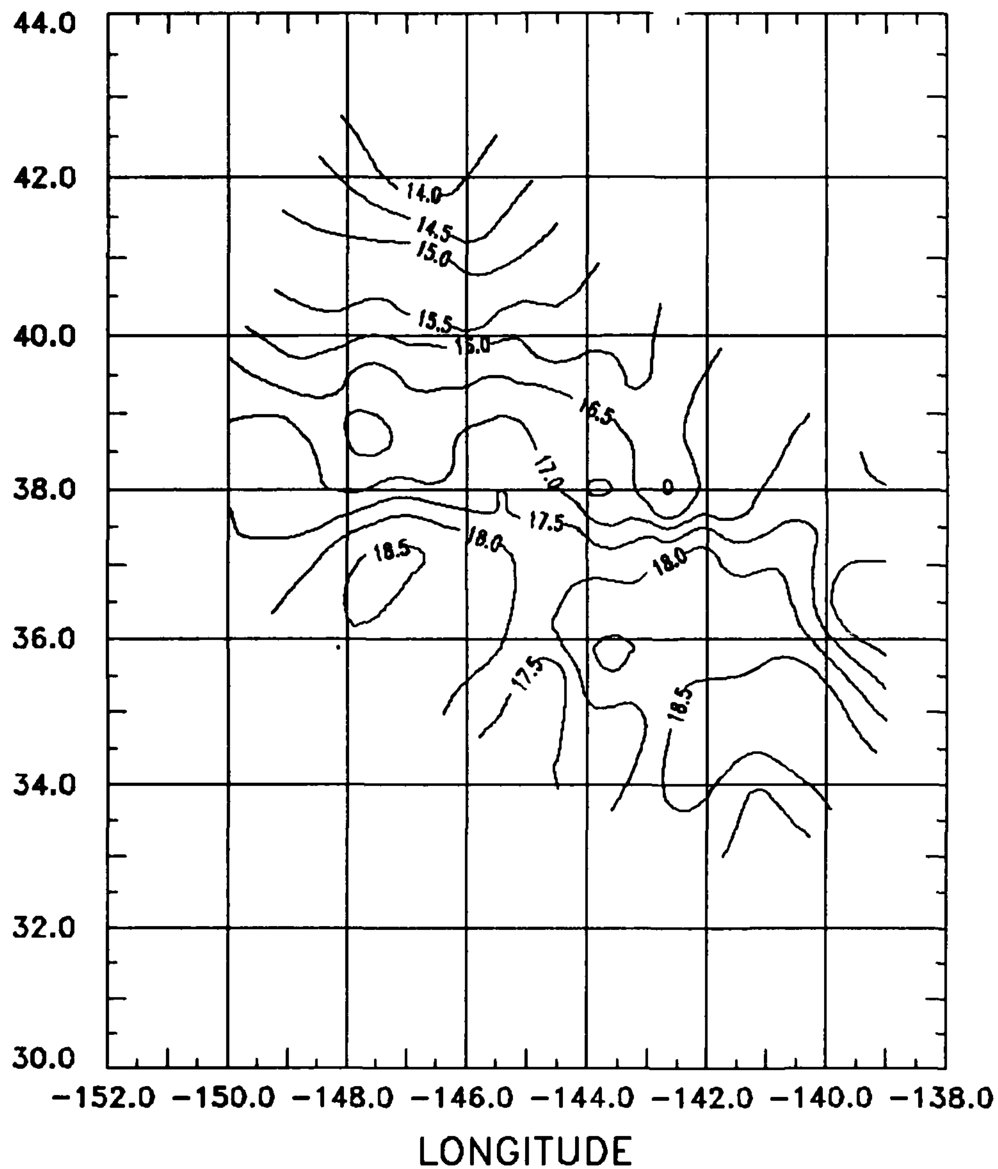


NOARL Code 331

7:41:59 2/12/90 dx=.3 ,dy=.3

NEPAC Grid 2

25 METERS TEMPERATURE (DEG C)

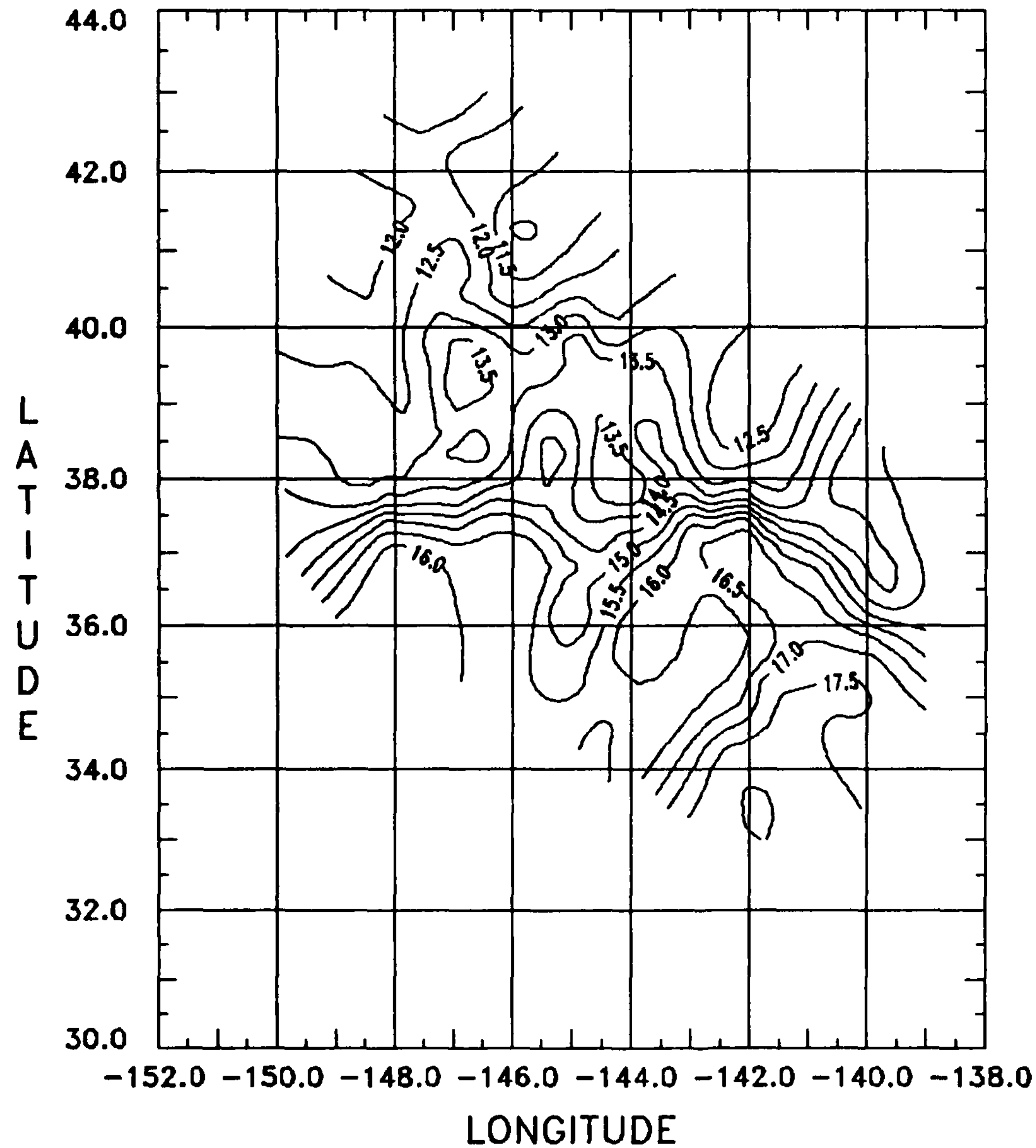


NOARL Code 331

7:42:52 2/12/90 dx=.3 ,dy=.3

NEPAC Grid 2

50 METERS TEMPERATURE (DEG C)



NOARL Code 331

7:43:49

2/12/90

dx=.3 ,dy=.3

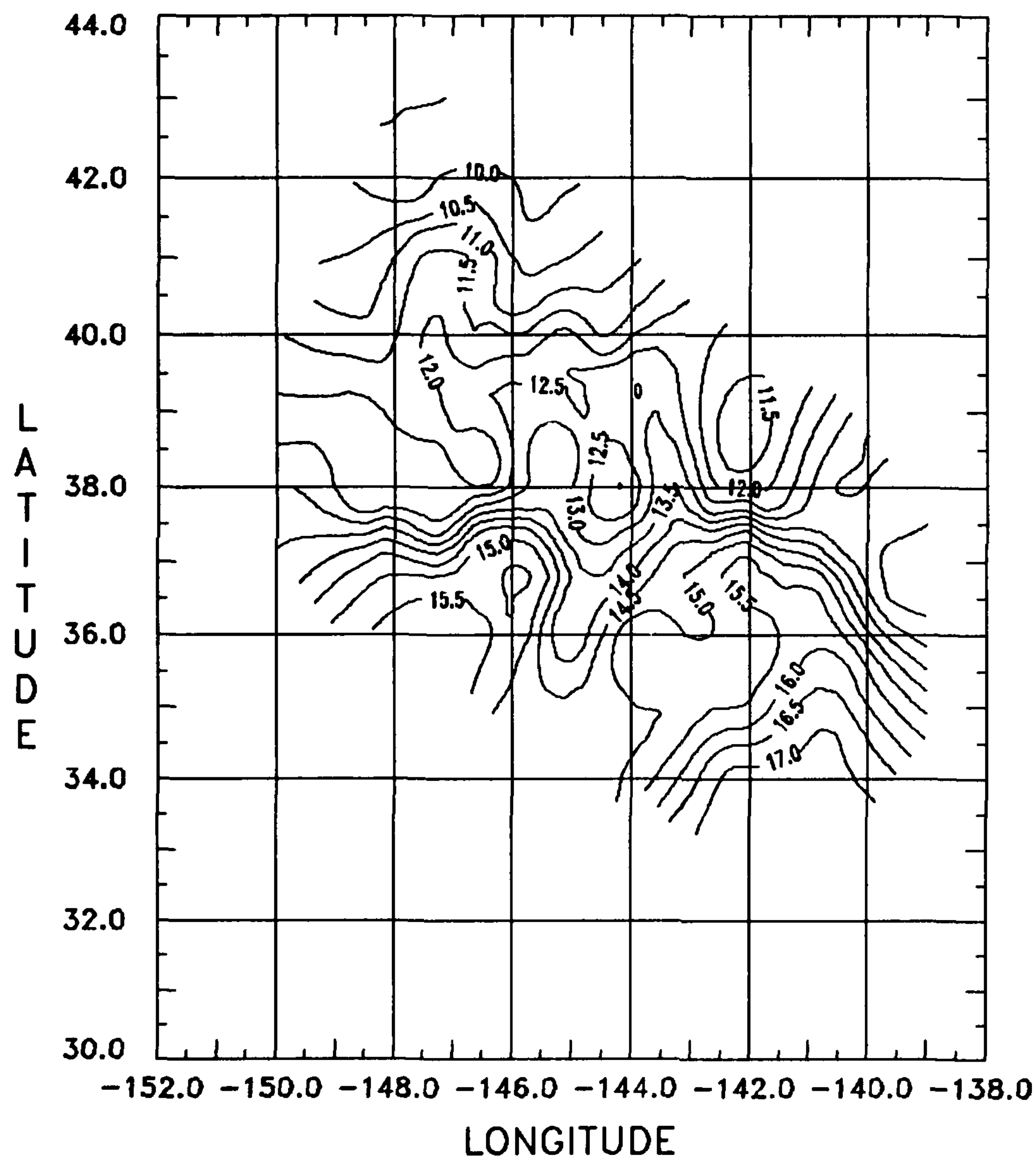
7:44:47

2/12/90

dx=.3 .dy=.3

NEPAC Grid 2

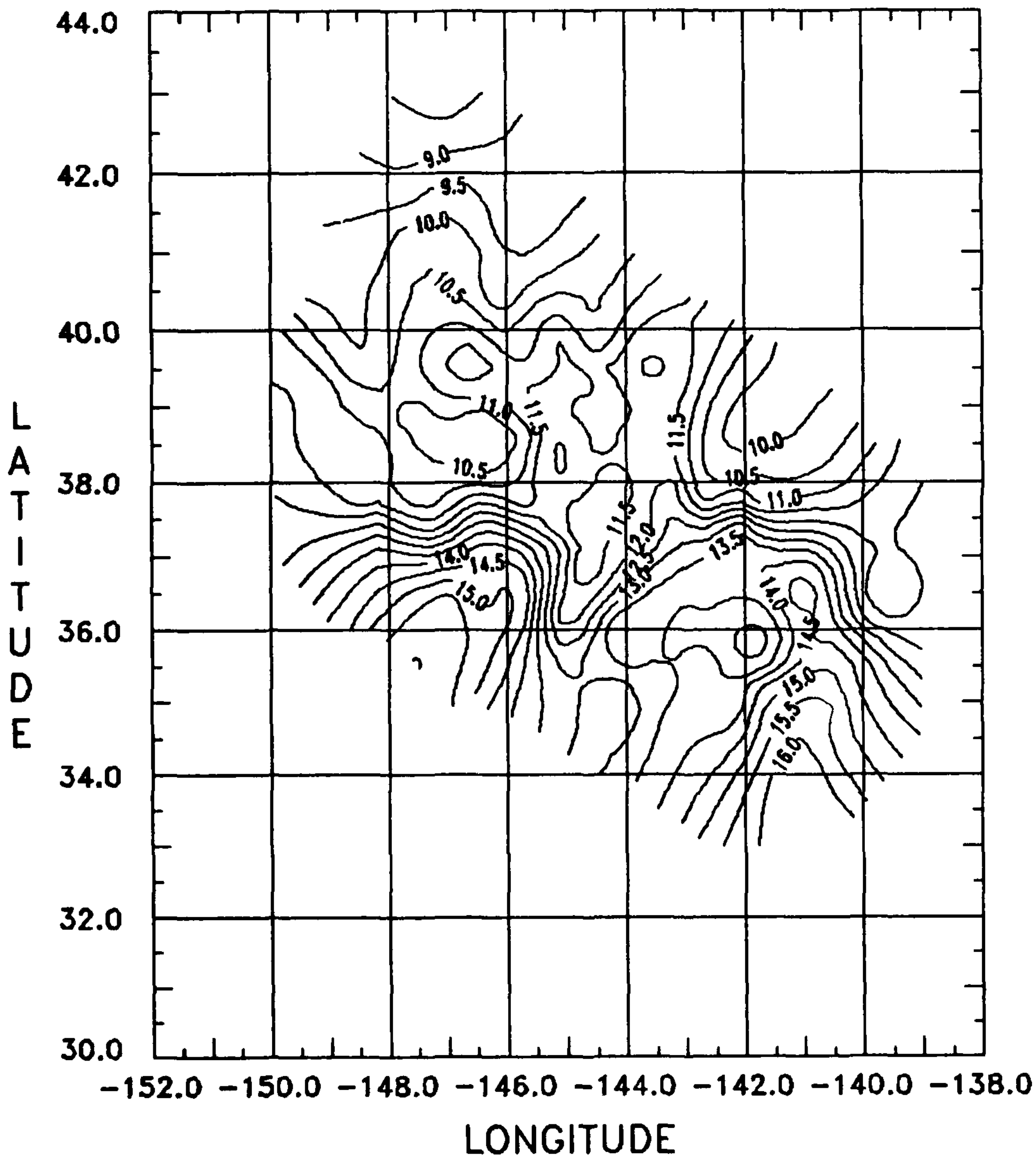
75 METERS TEMPERATURE (DEG C)



NOARL Code 331

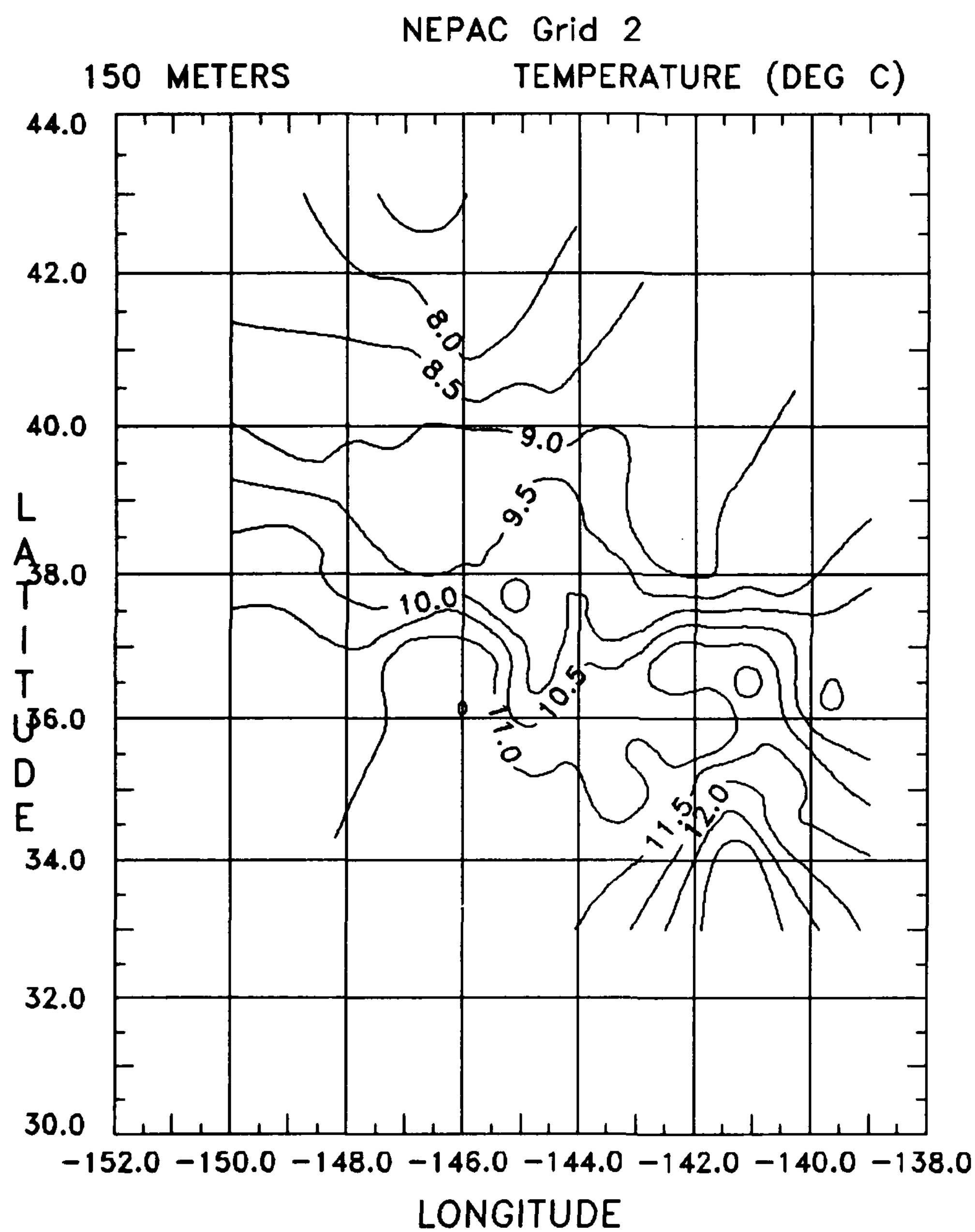
NEPAC Grid 2

100 METERS TEMPERATURE (DEG C)



NOARL Code 331

7:45:47 2/12/90 dx=.3 ,dy=.3



NOARL Code 331

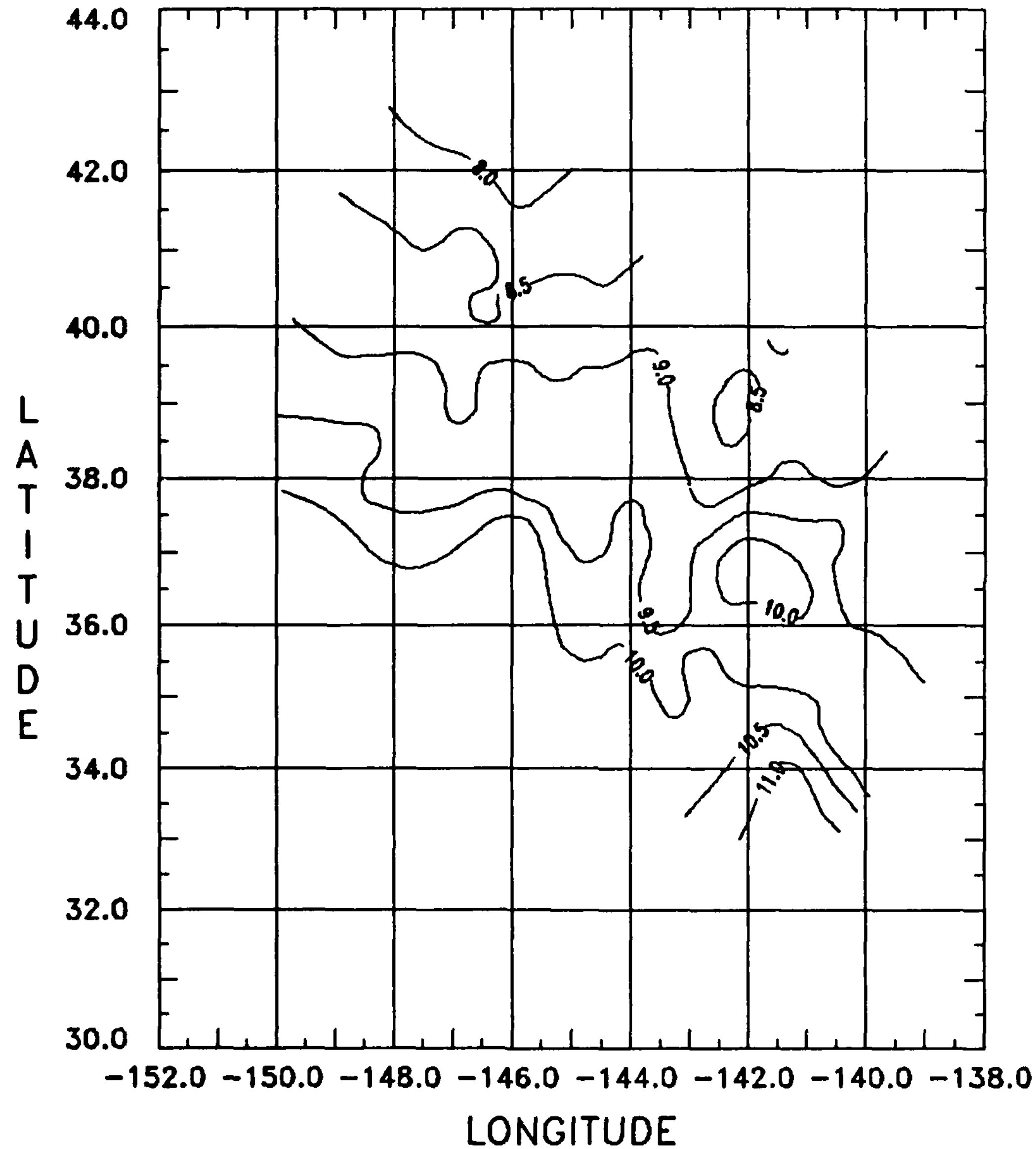
8:31:45

11/28/89

dx=.3 ,dy=.3

NEPAC Grid 2

200 METERS TEMPERATURE (DEG C)

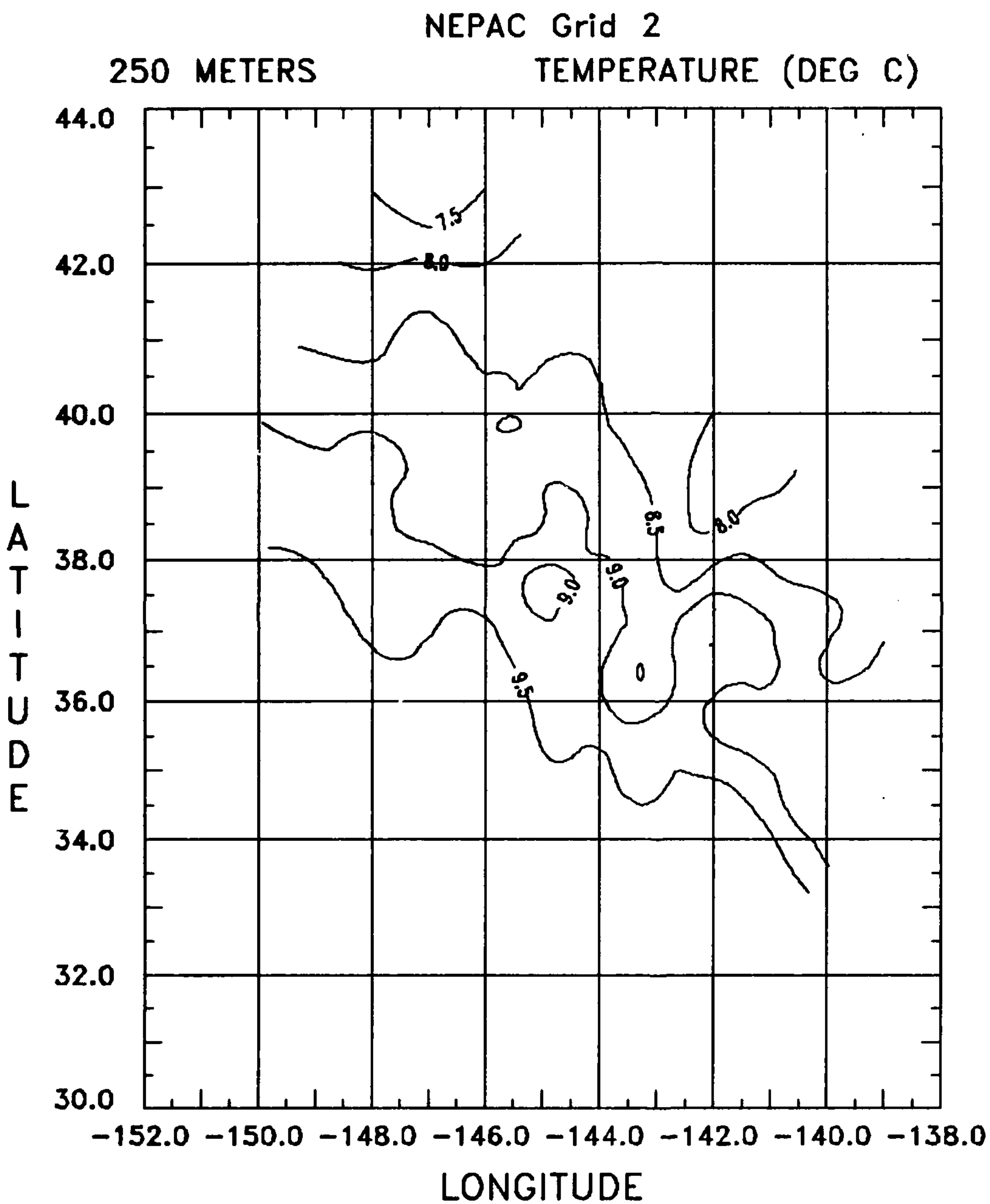


7:47:34

2/12/90

dx=.3 ,dy=.3

NOARL Code 331

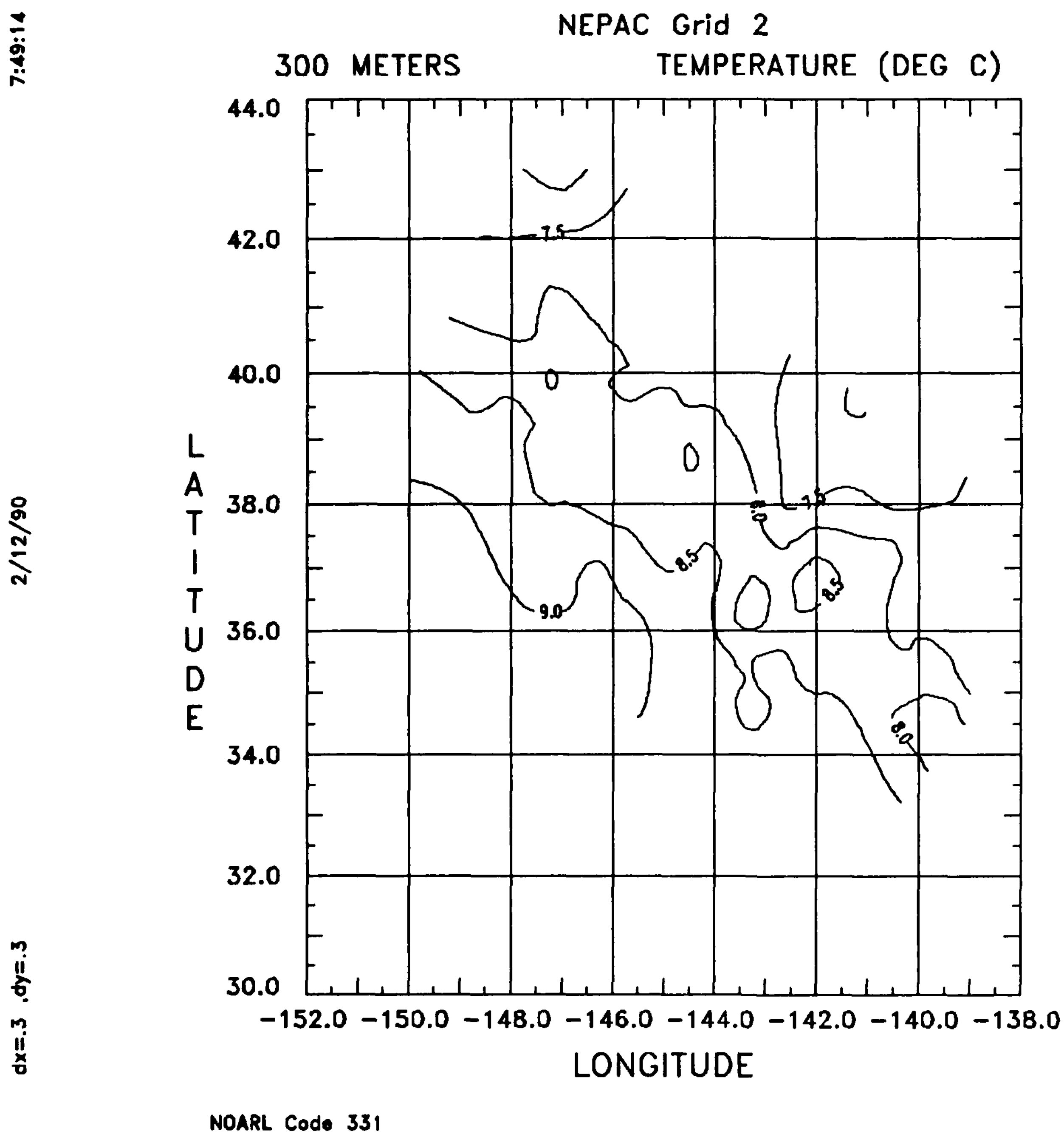


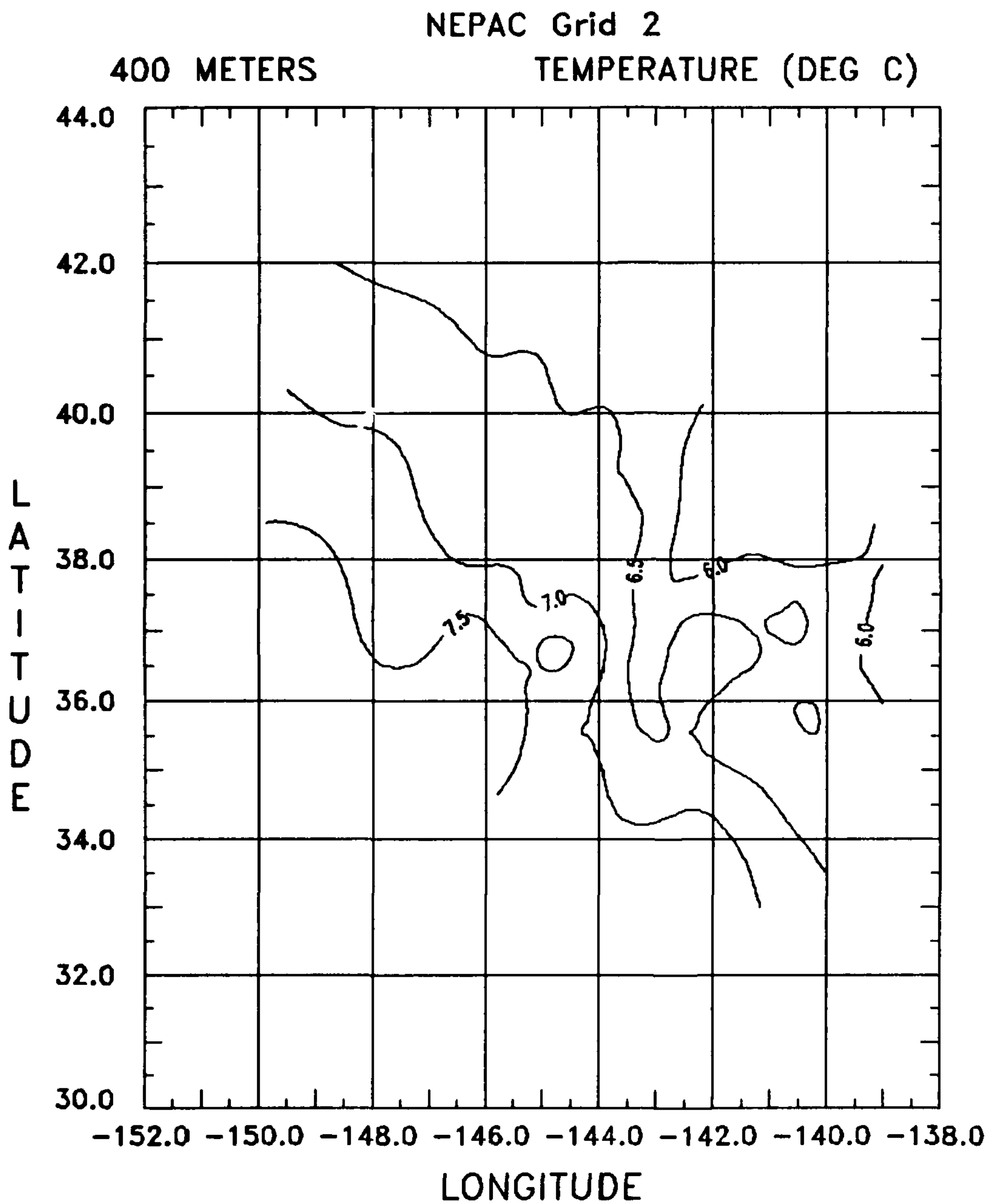
NOARL Code 331

7:48:24

2/12/90

dx=.3 .dy=.3


NEPAC Grid 2
300 METERS
TEMPERATURE (DEG C)
LATITUDE
LONGITUDE
44.0
42.0
40.0
38.0
36.0
34.0
32.0
30.0
−152.0 −150.0 −148.0 −146.0 −144.0 −142.0 −140.0 −138.0
7.5
8.0
8.5
9.0
7:49:14
2/12/90
dx=.3 .dy=.3
NOARL Code 331

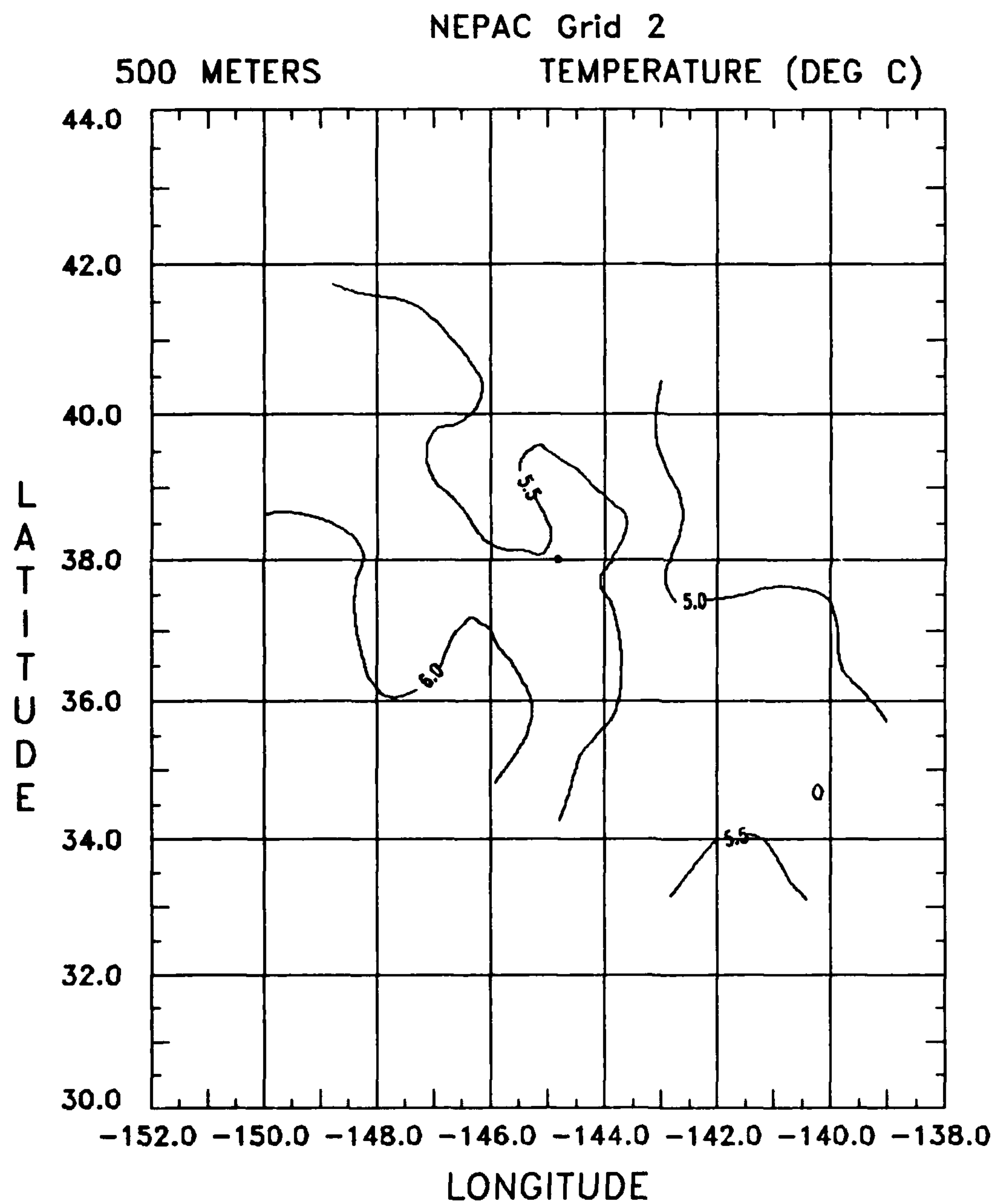


NOARL Code 331

7:50:03

2/12/90

dx=.3 .dy=.3

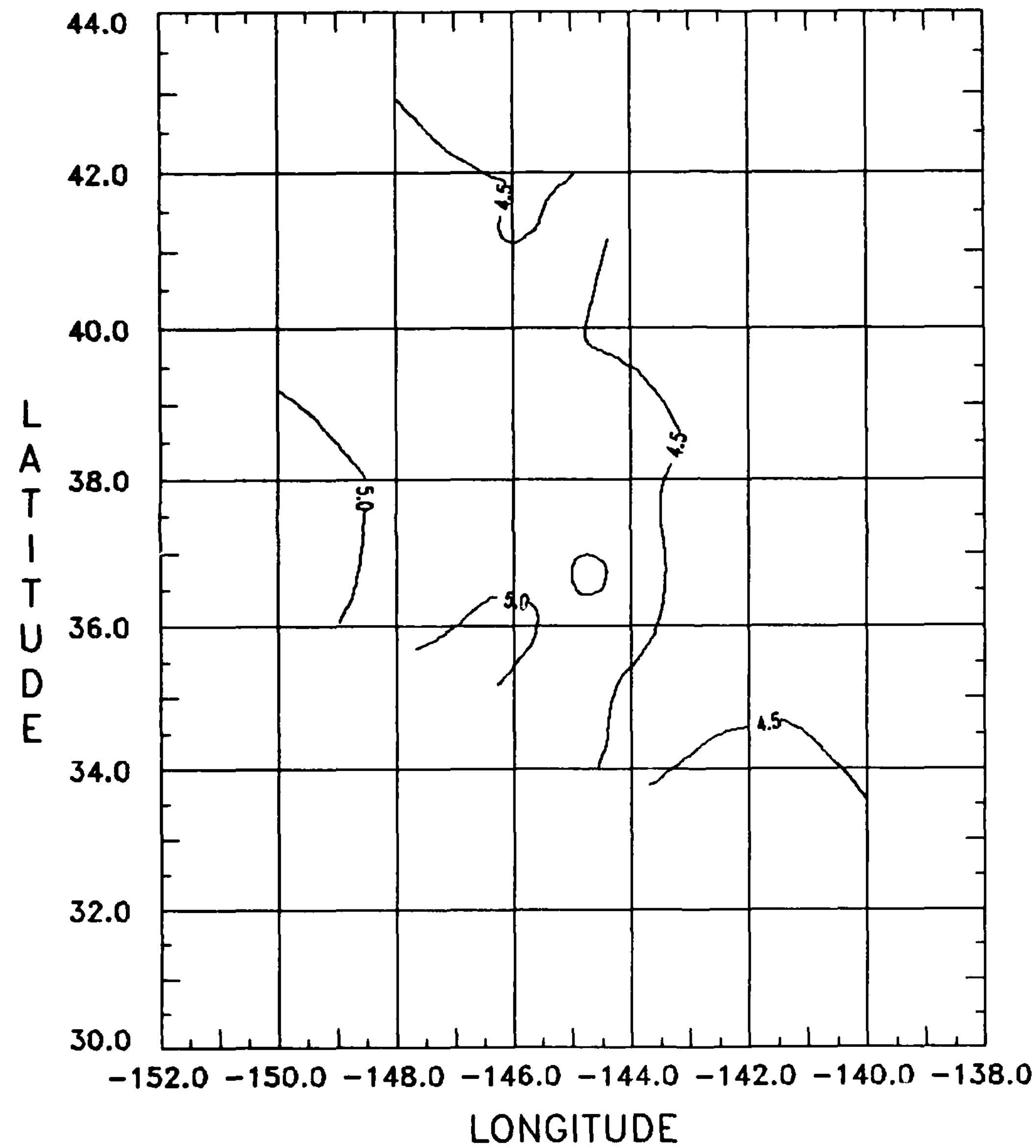


NOARL Code 331

7:50:50 2/12/90 dx=.3 ,dy=.3

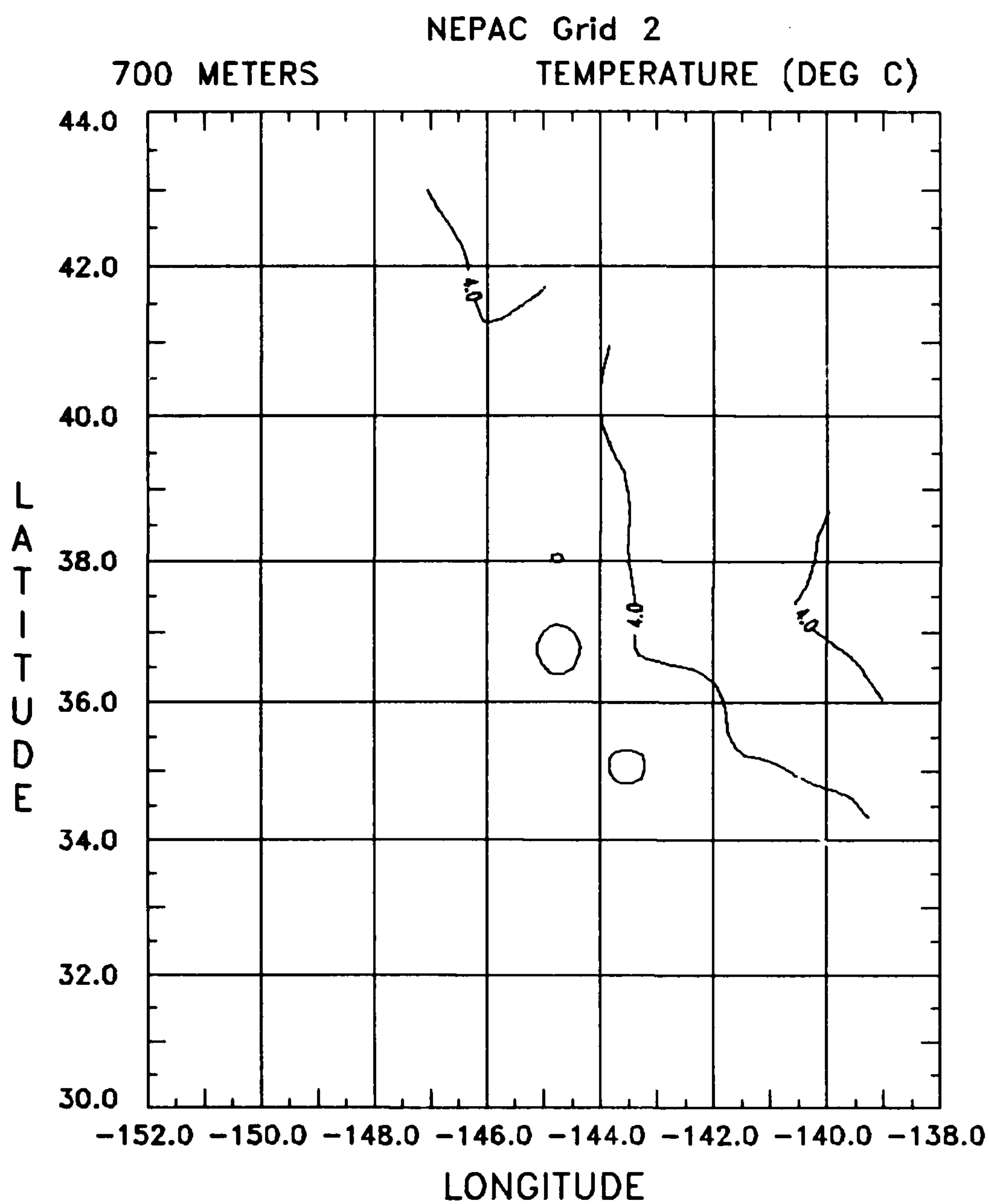
NEPAC Grid 2

600 METERS TEMPERATURE (DEG C)



NOARL Code 331

7:51:38 2/12/90 dx=.3 ,dy=.3



NOARL Code 331

7:52:22

?/12/90

dx=.3 ,dy=.3

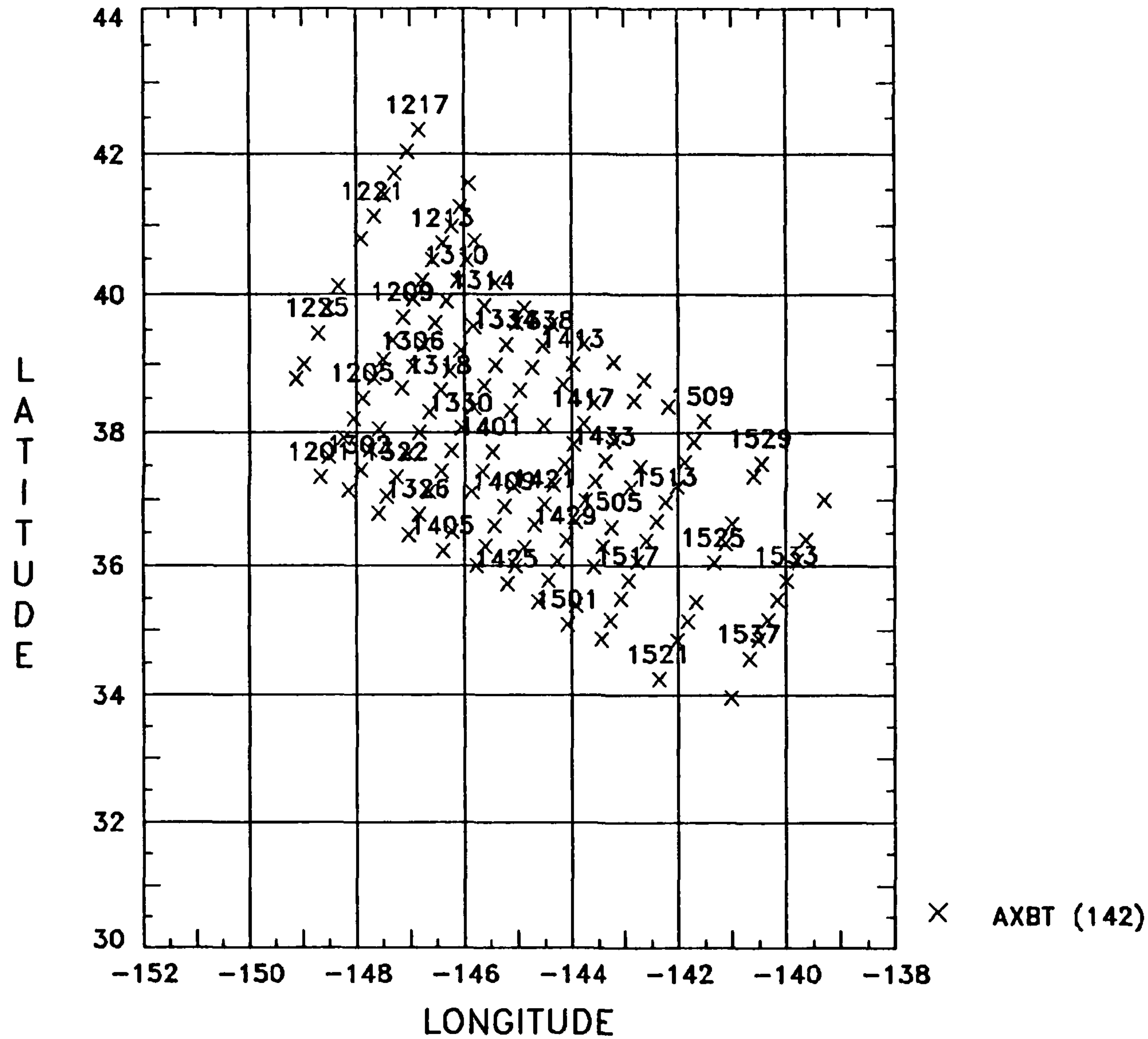
Appendix C.

NEPAC Grid 2 (6 - 7 July 1989)

Inferred Salinity Contours at Selected Depths

NEPAC Grid 2 (6–7 July 1989)

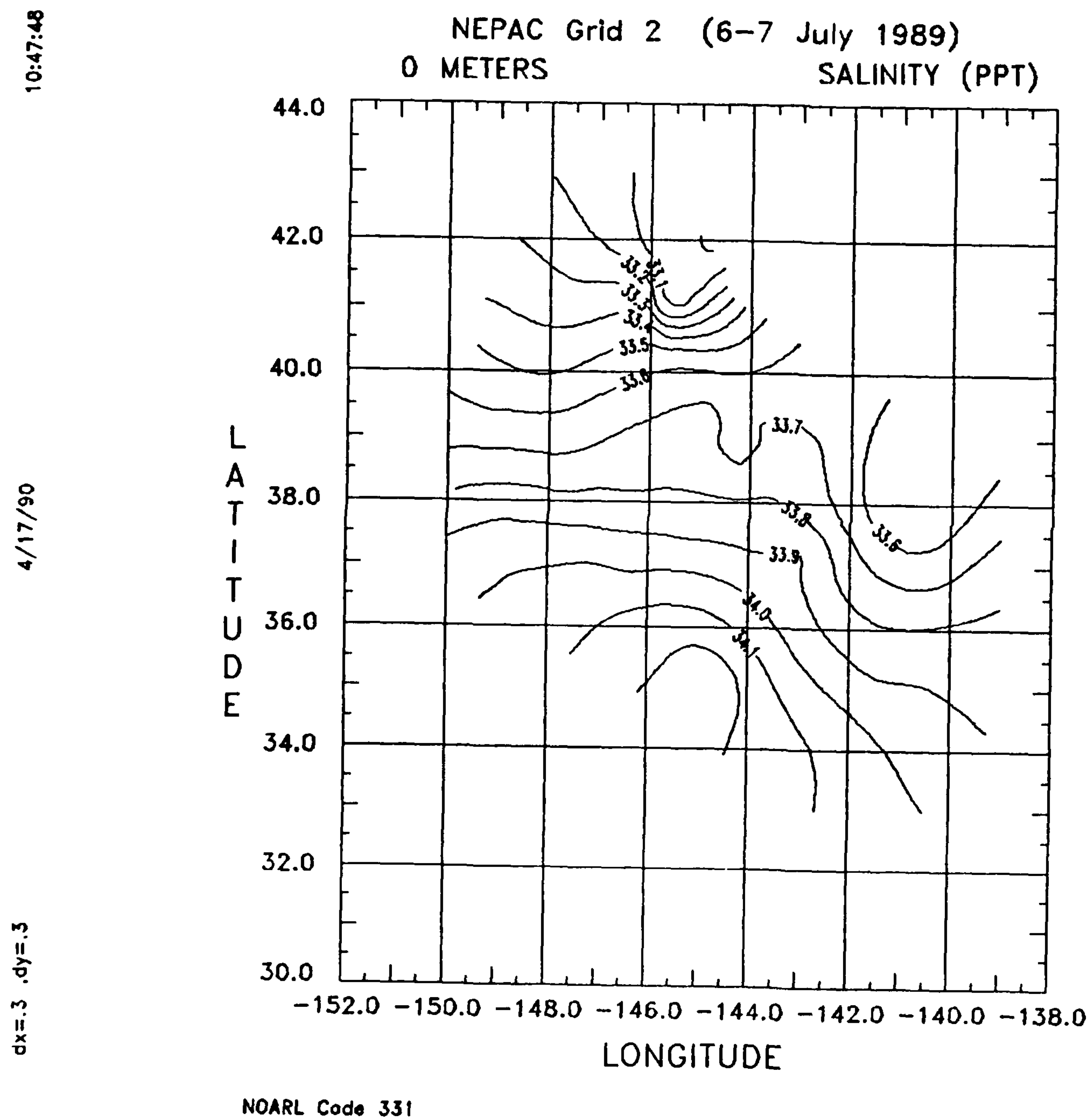
142 Probes



NOARL Code 331

8:55:51

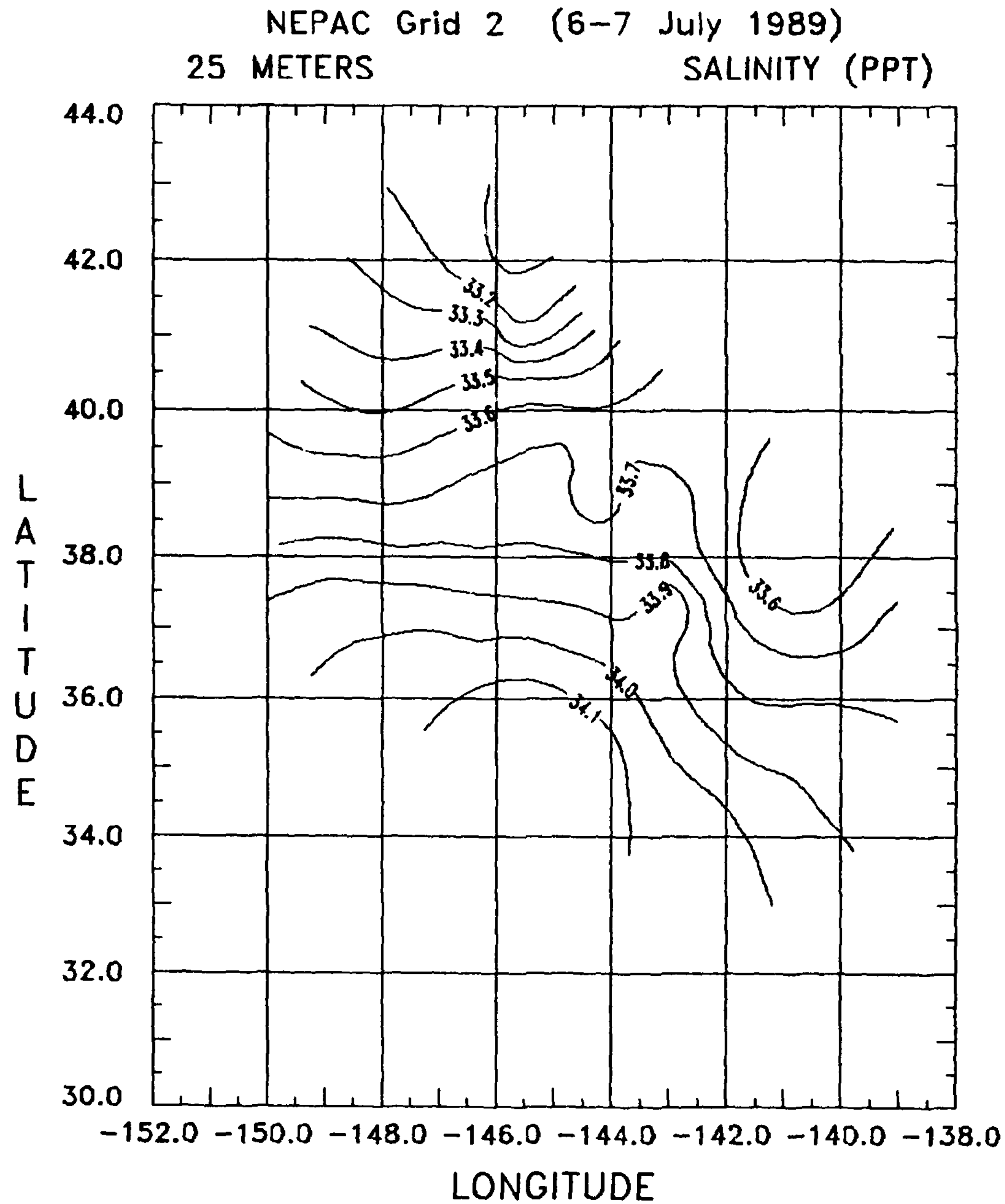
5/09/90


NEPAC Grid 2 (6–7 July 1989)
0 METERS
SALINITY (PPT)
44.0
42.0
40.0
38.0
36.0
34.0
32.0
30.0
LATITUDE
−152.0 −150.0 −148.0 −146.0 −144.0 −142.0 −140.0 −138.0
LONGITUDE
33.1
33.2
33.3
33.4
33.5
33.6
33.7
33.8
33.9
34.0
34.1
NOARL Code 331
10:47:48
4/17/90
dx=.3 .dy=.3

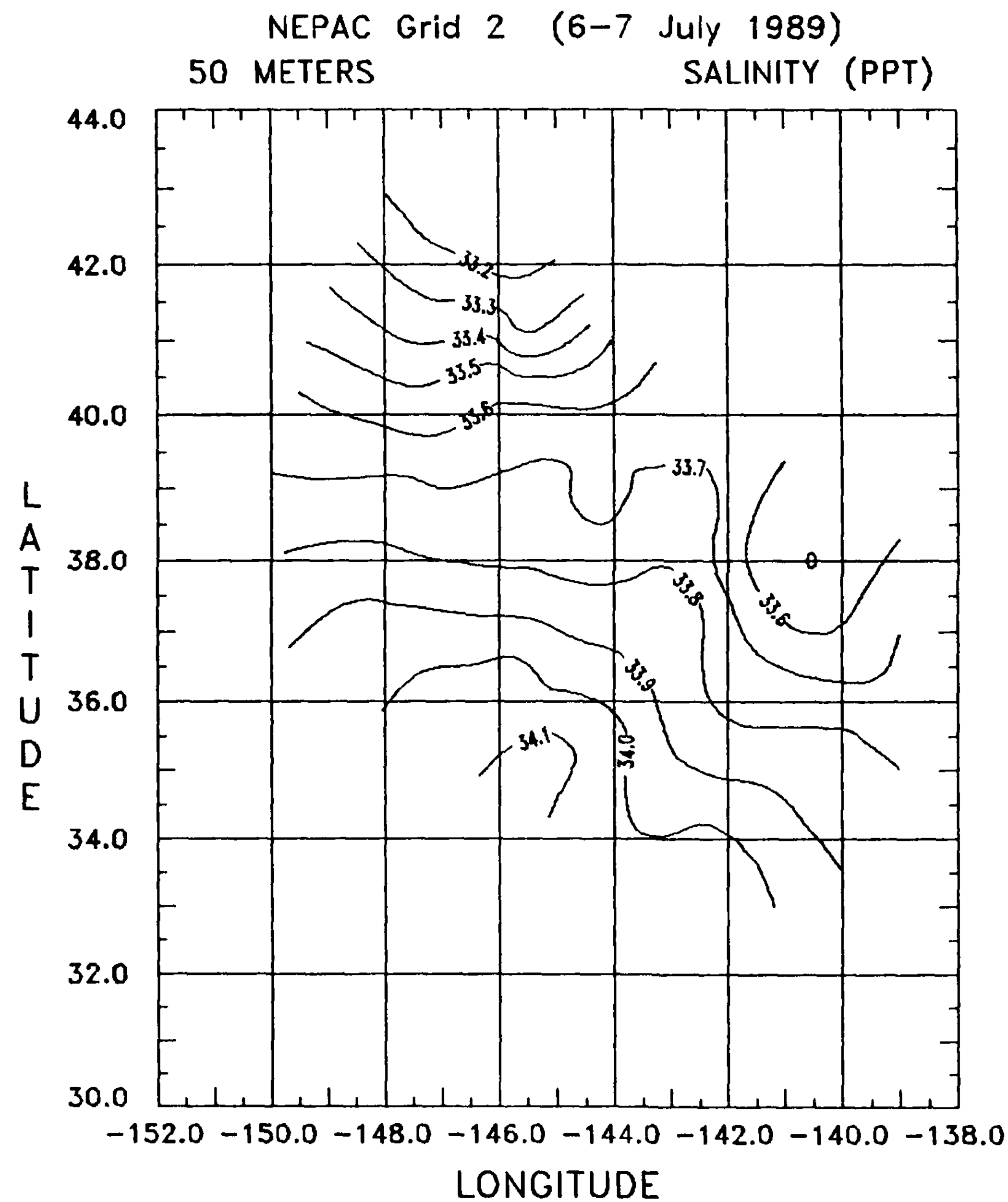
12:28:05

4/17/90

dx=.3 .dy=.3

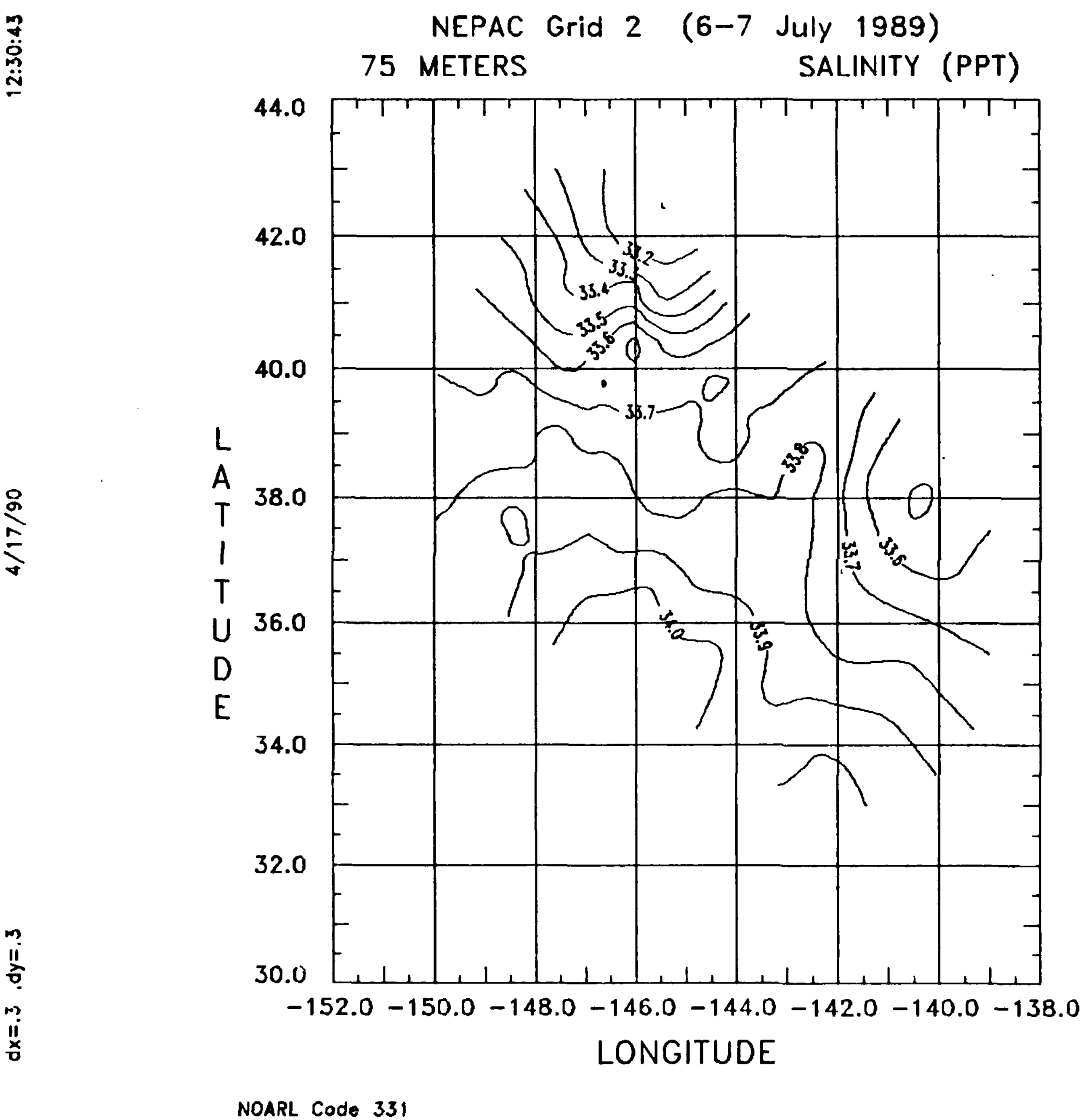


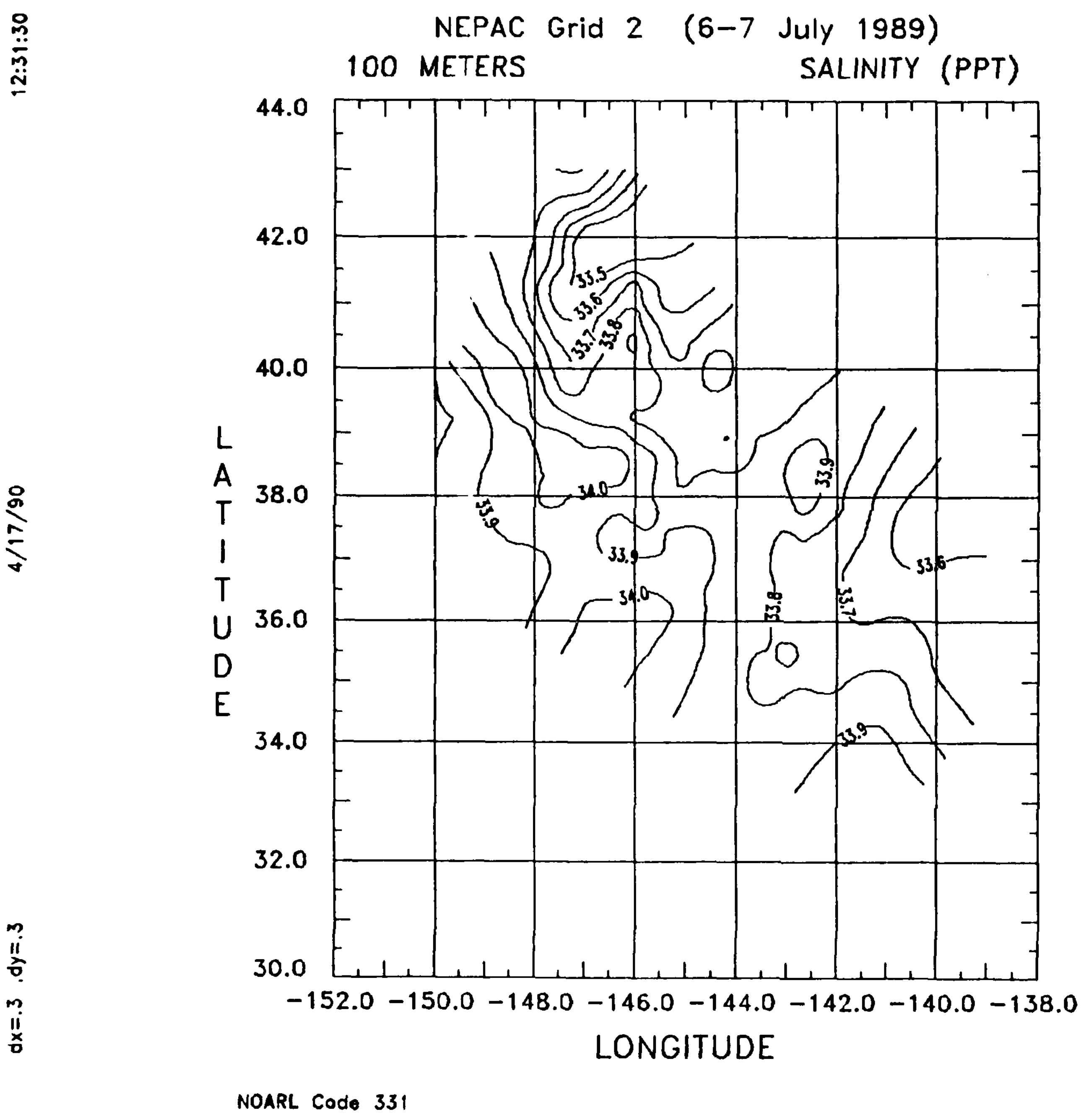
NOARL Code 331

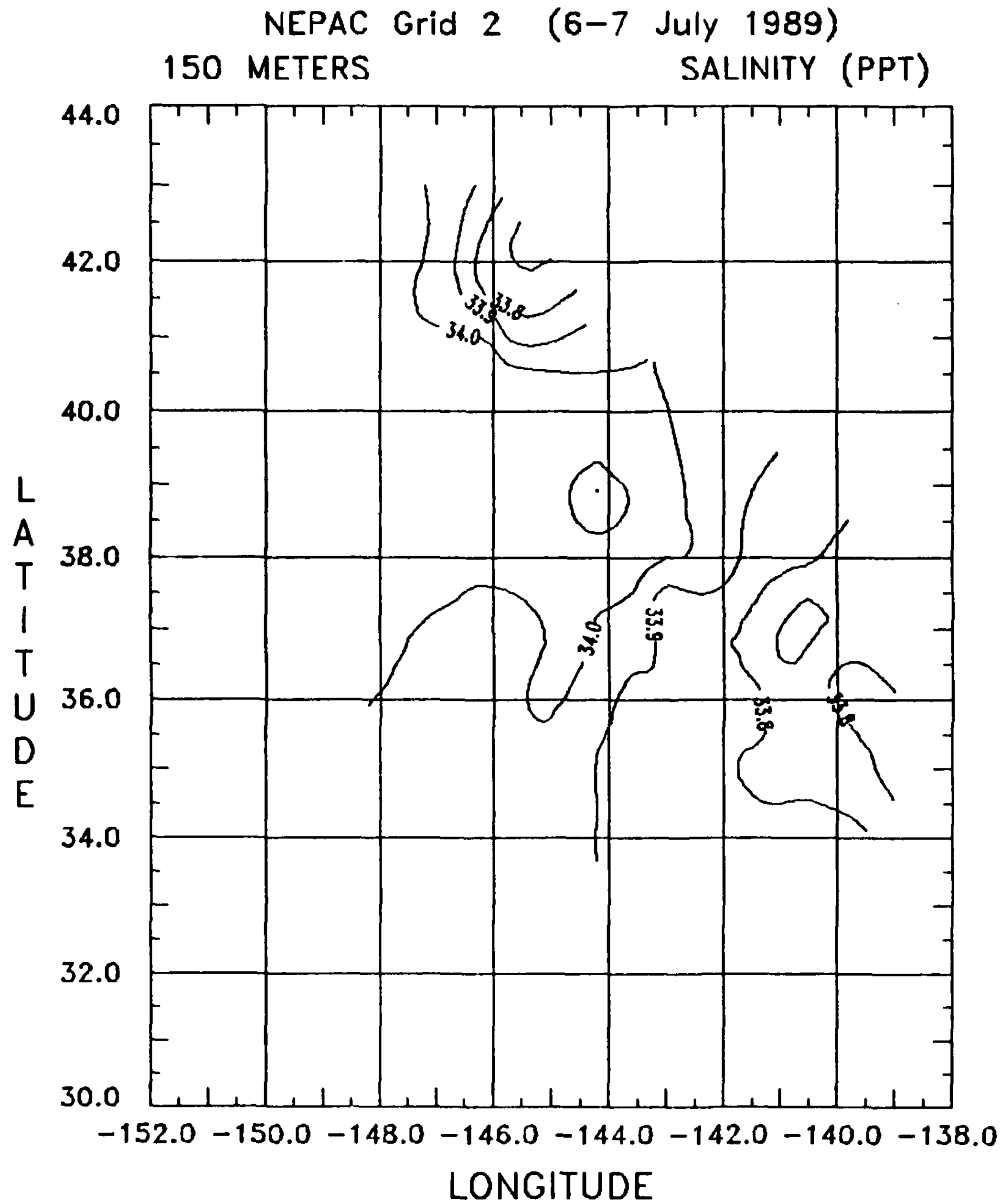


NOARL Code 331

12:29:58 4/17/90 dx=.3 ,dy=.3

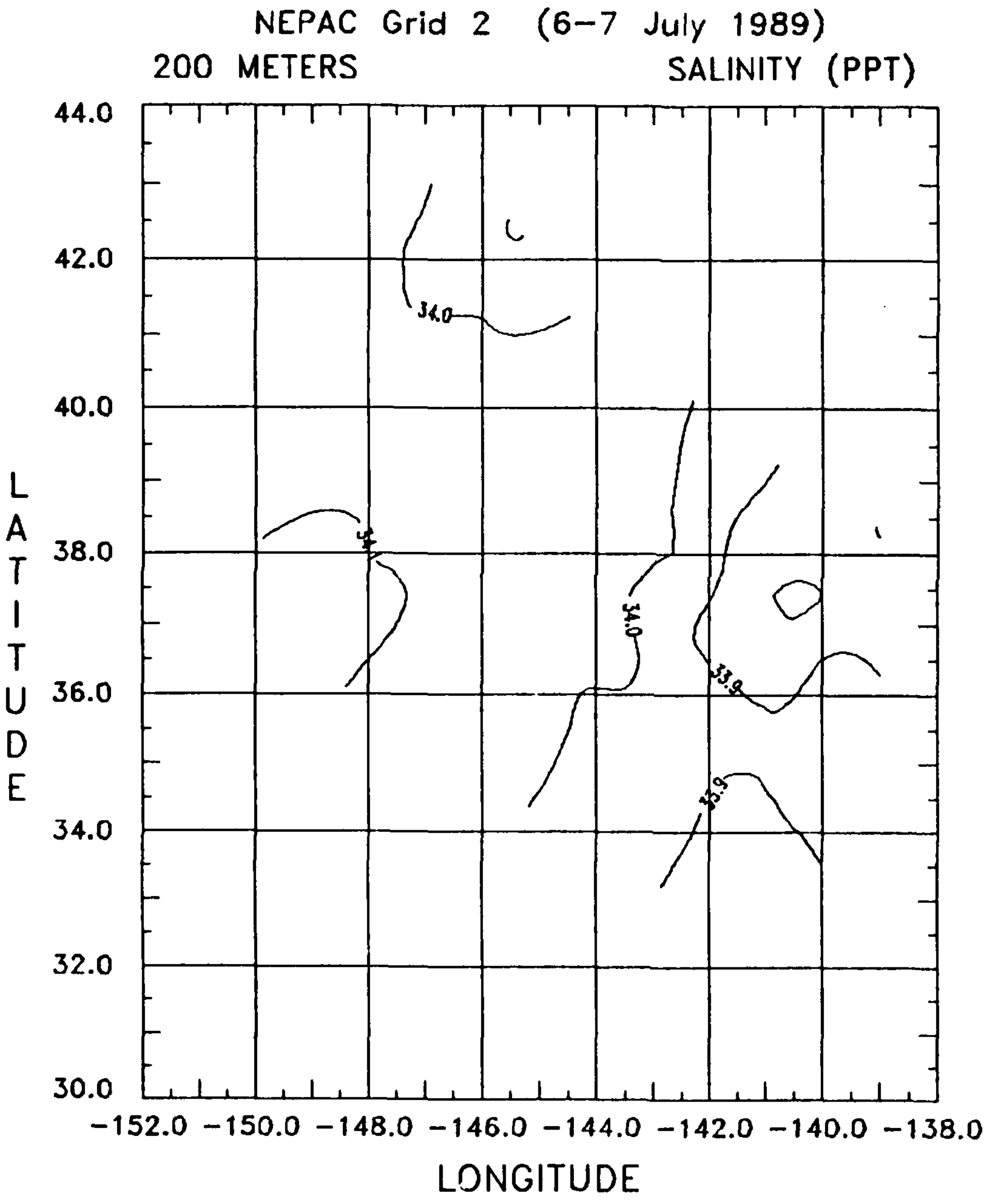

12:30:43
NEPAC Grid 2 (6–7 July 1989)
75 METERS
SALINITY (PPT)
LATITUDE
44.0
42.0
40.0
38.0
36.0
34.0
32.0
30.0
33.2
33.4
33.5
33.6
33.7
33.8
33.9
34.0
−152.0 −150.0 −148.0 −146.0 −144.0 −142.0 −140.0 −138.0
LONGITUDE
NOARL Code 331
4/17/90
dx=.3 .dy=.3


NEPAC Grid 2 (6–7 July 1989)
100 METERS
SALINITY (PPT)
LATITUDE
LONGITUDE
44.0
42.0
40.0
38.0
36.0
34.0
32.0
30.0
−152.0 −150.0 −148.0 −146.0 −144.0 −142.0 −140.0 −138.0
33.5
33.6
33.7
33.8
33.9
34.0
NOARL Code 331
12:31:30
4/17/90
dx=.3 .dy=.3



NOARL Code 331

12:32:14 4/17/90 dx=.3 .dy=.3

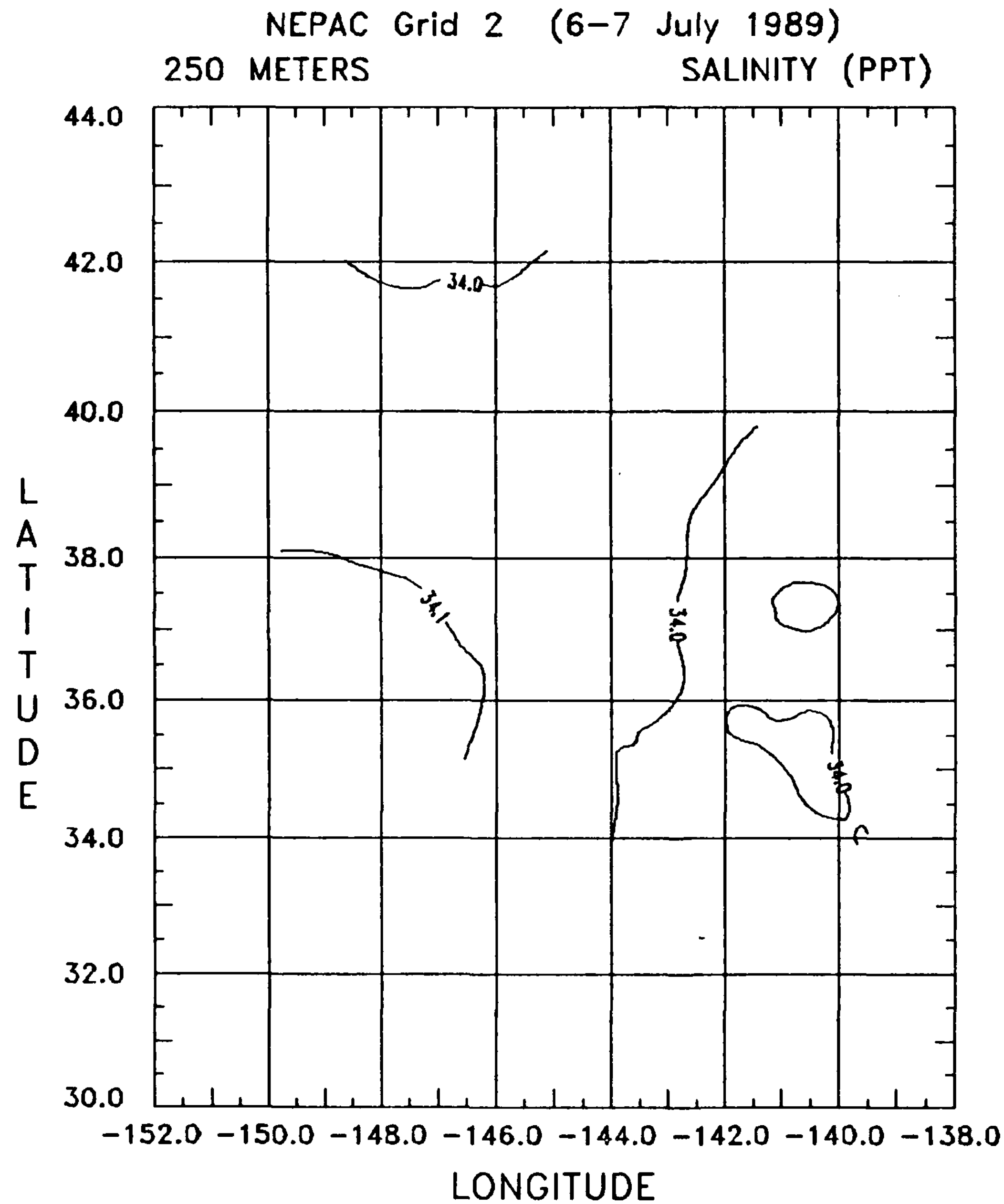


NOARL Code 331

12:32:54

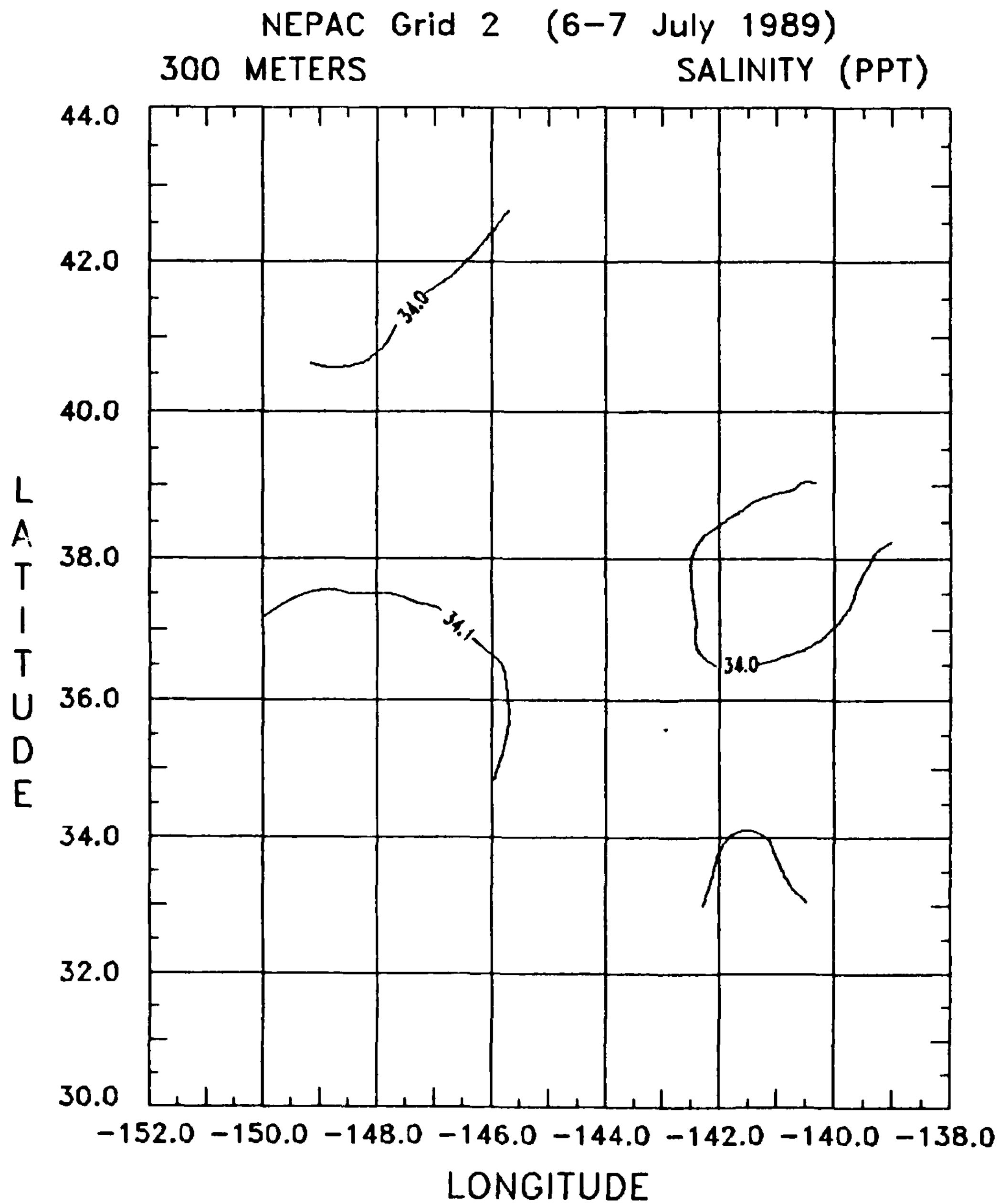
4/17/90

dx=.3 .dy=.3



NOARL Code 331

12:33:33 4/17/90 dx=.3 ,dy=.3

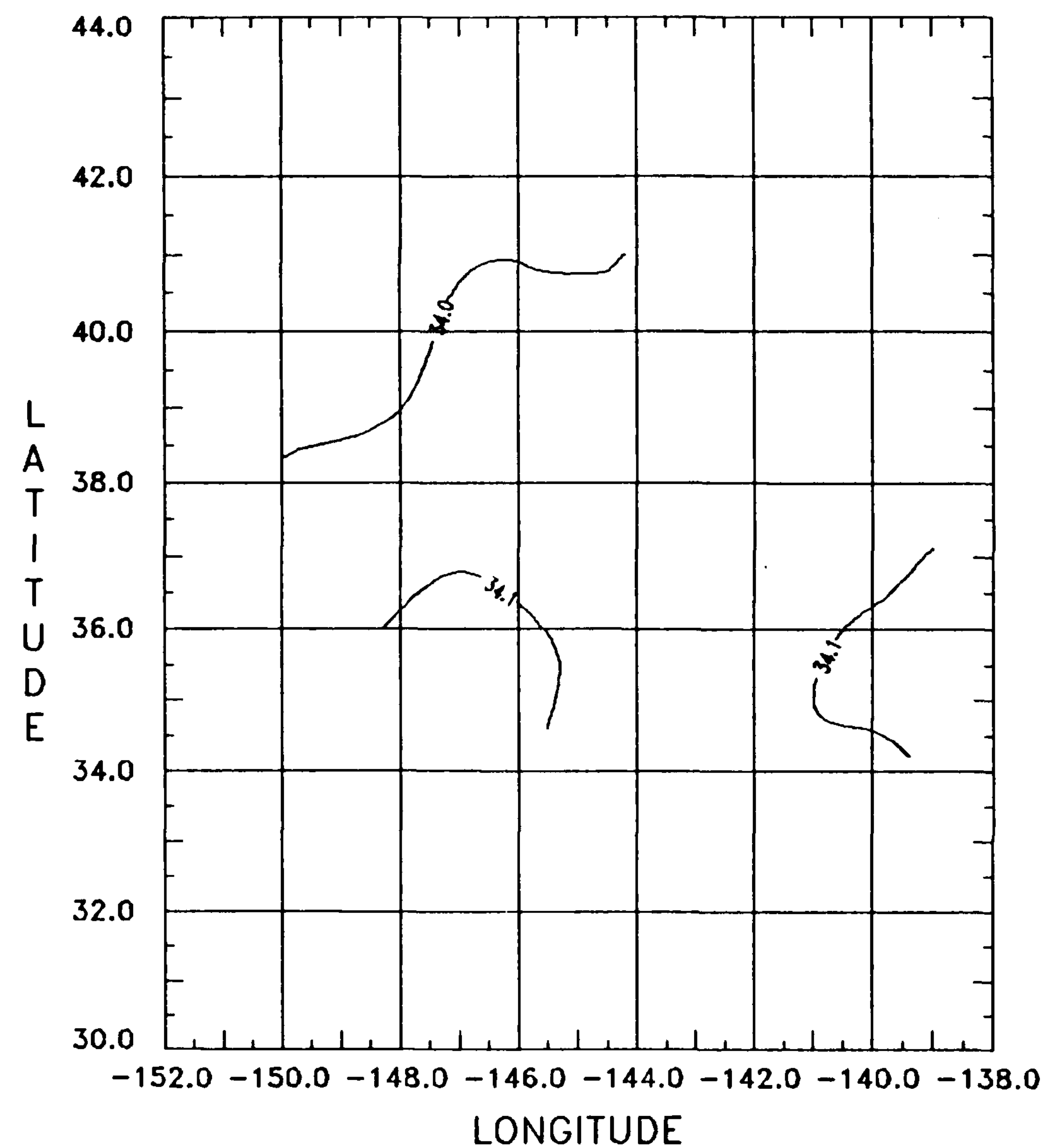


NOARL Code 331

12:34:11 4/17/90 dx=.3 .dy=.3

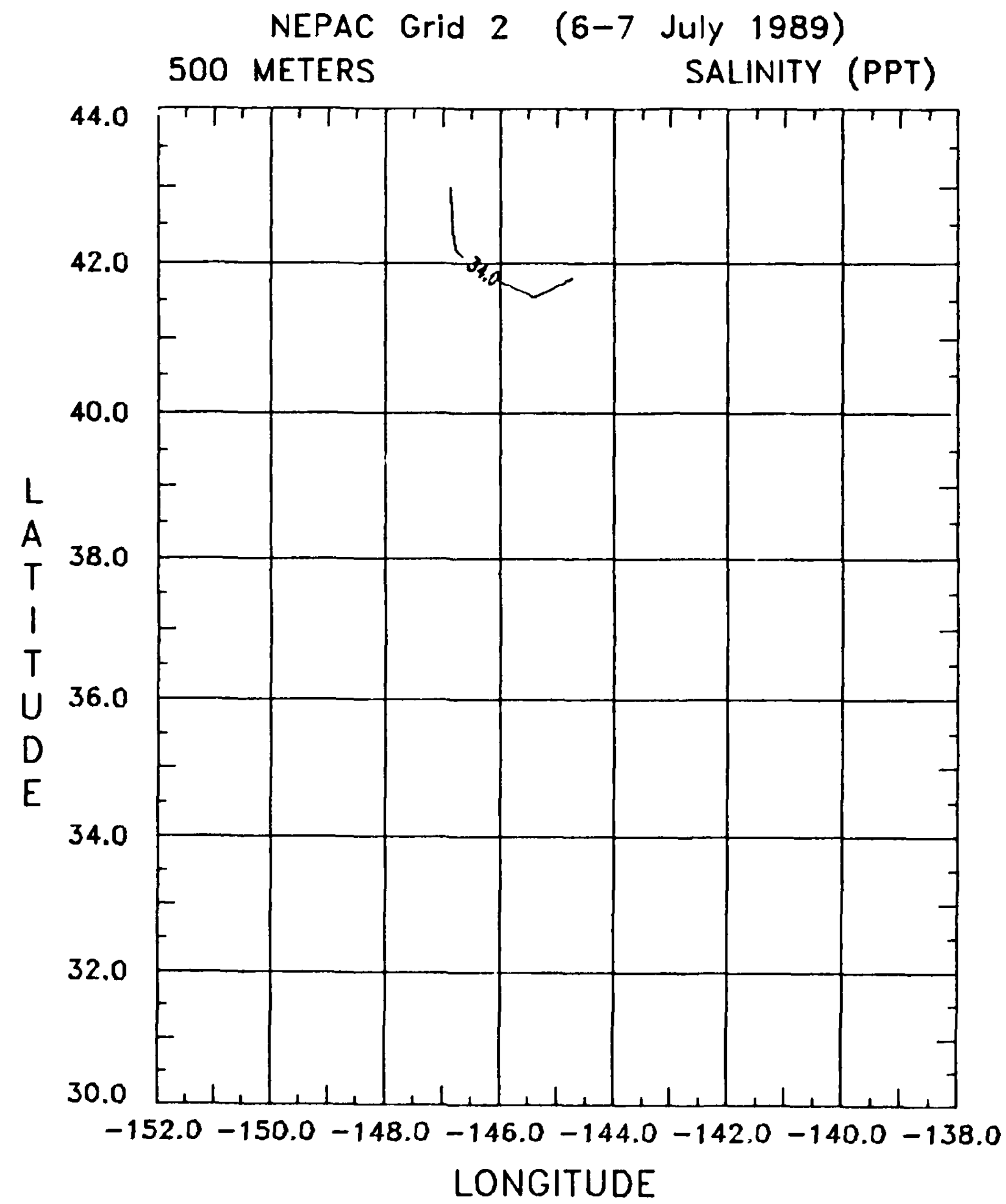
NEPAC Grid 2 (6–7 July 1989)

400 METERS SALINITY (PPT)



NOARL Code 331

12:34:48 4/17/90 dx=.3 .dy=.3

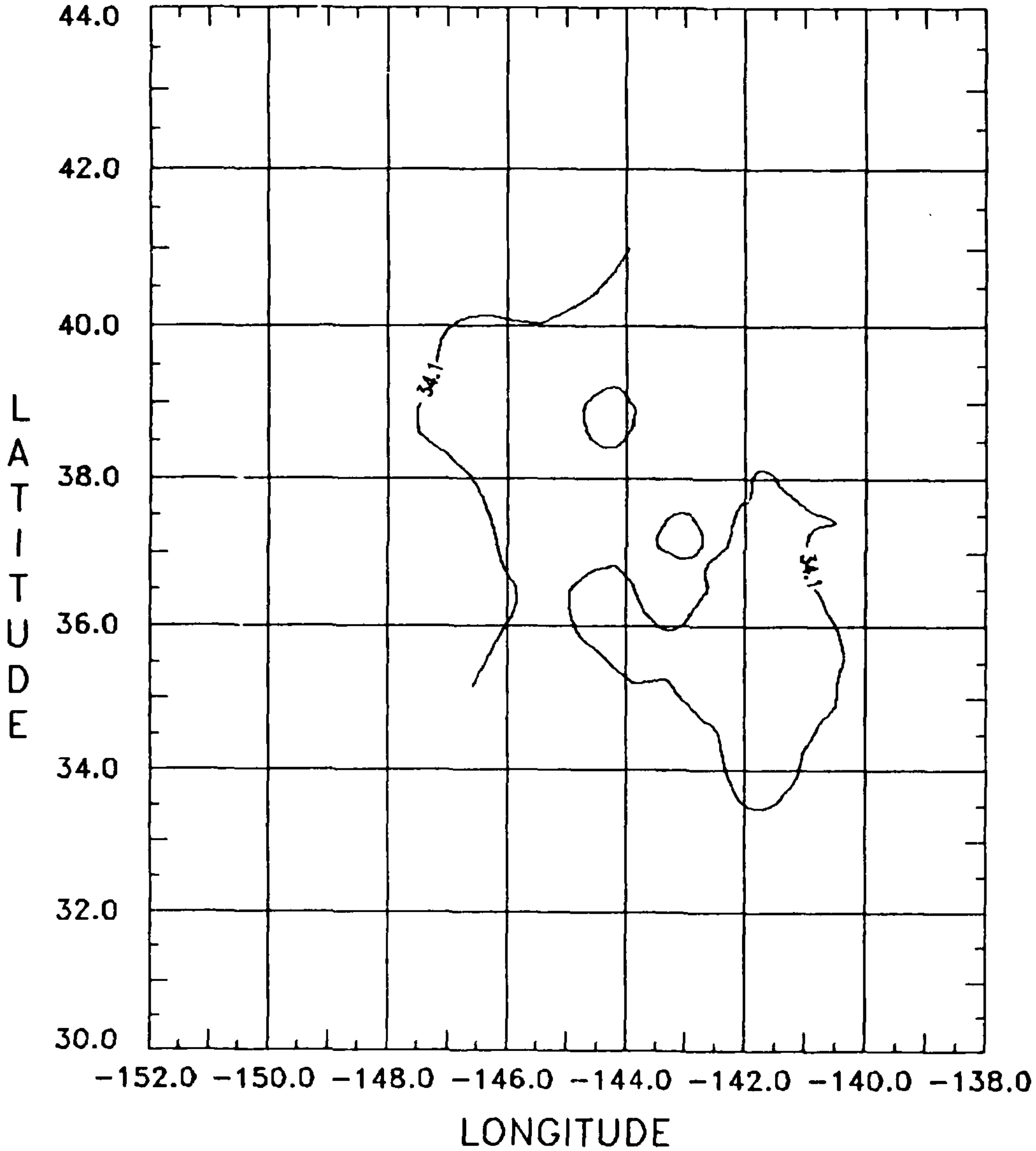


NOARL Code 331

12:35:23 4/17/90 dx=.3 ,dy=.3

NEPAC Grid 2 (6–7 July 1989)

600 METERS SALINITY (PPT)

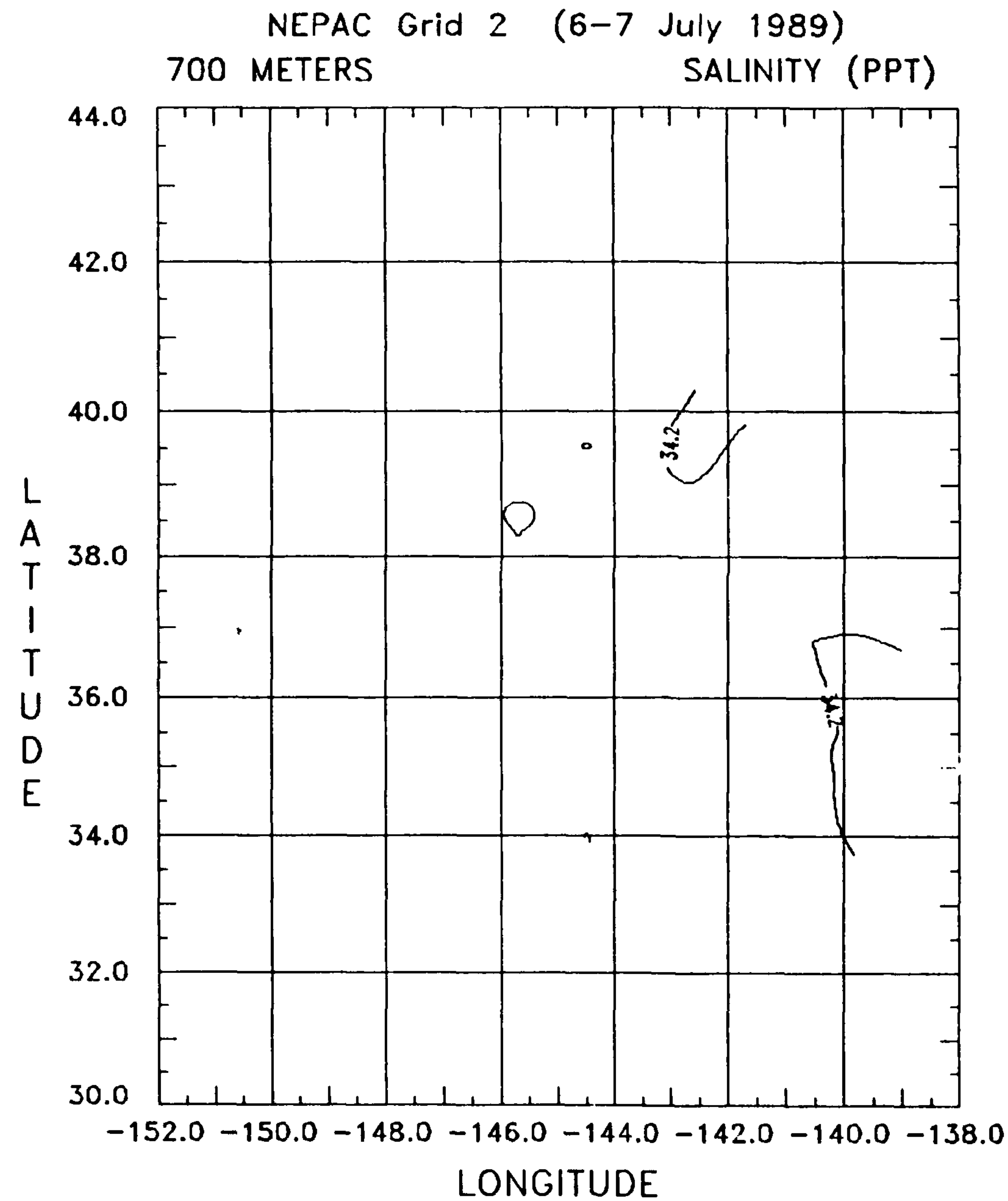


NOARL Code 331

12:35:59

4/17/90

dx=.3 .dy=.3



NOARL Code 331

12:36:36 4/17/90 dx=.3 ,dy=.3

Appendix D.

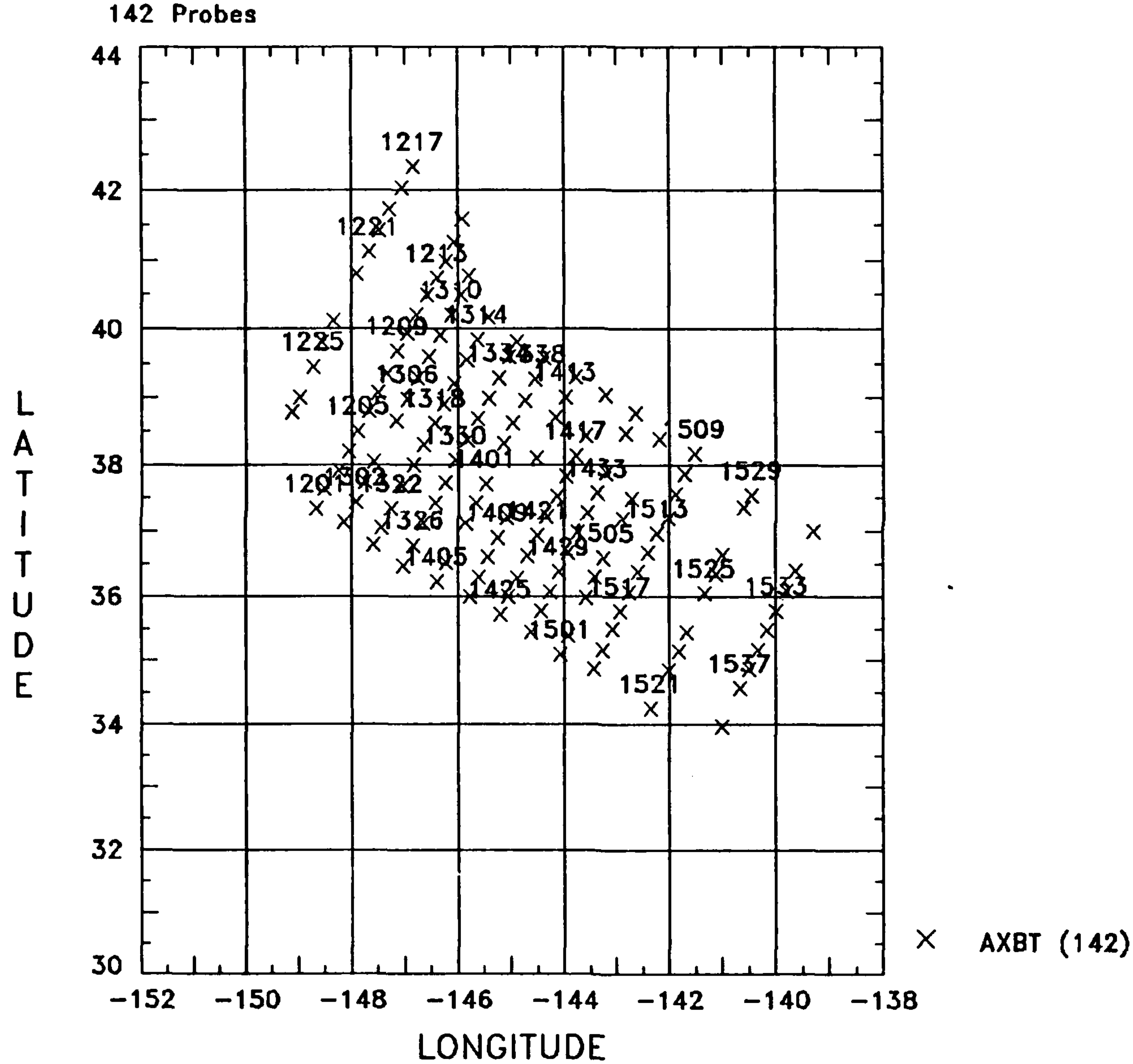
NEPAC Grid 2 (6 - 7 July 1989)

Computed Sound Speed Contours at Selected Depths

8:55:51

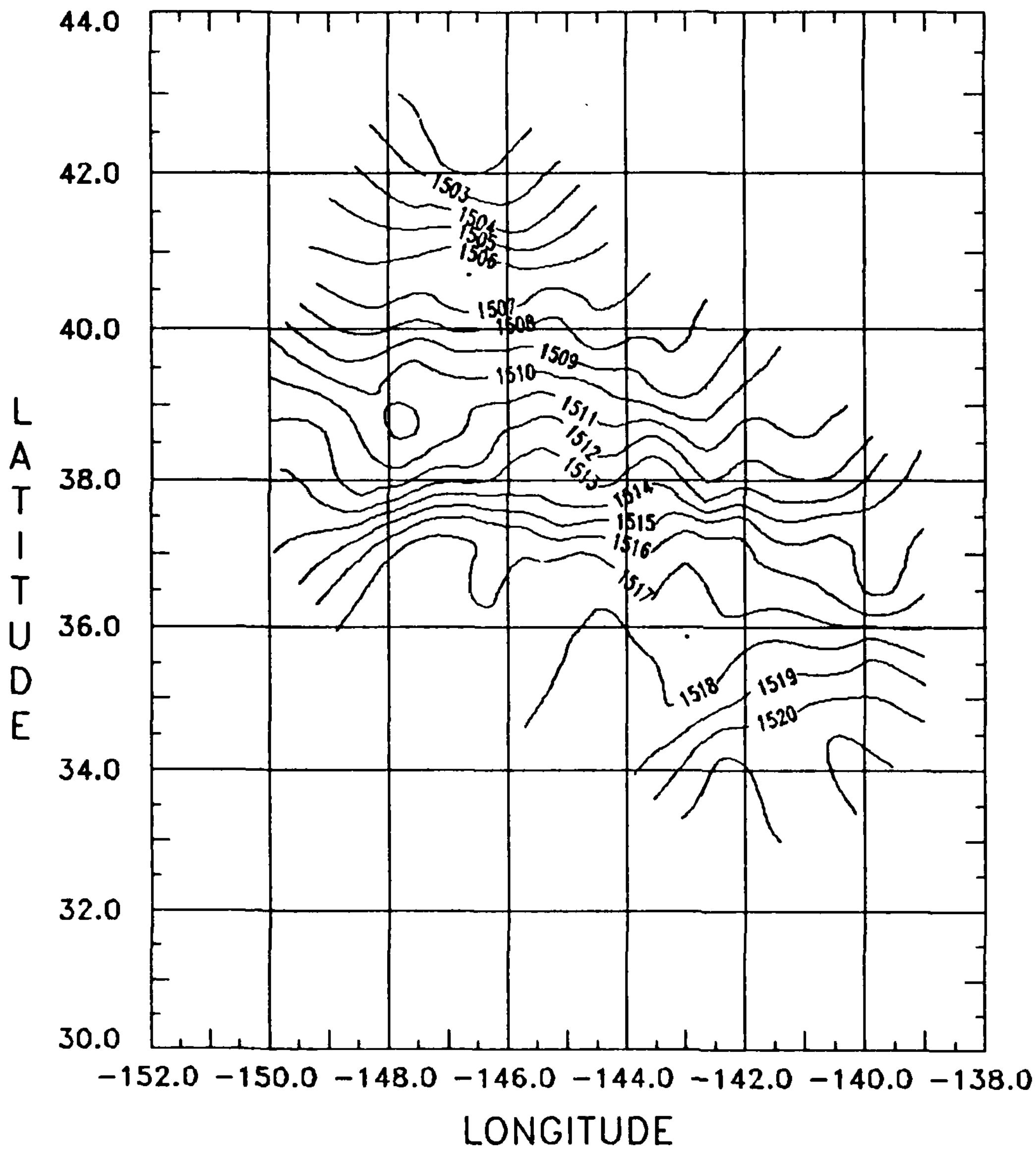
5/09/90

NEPAC Grid 2 (6–7 July 1989)



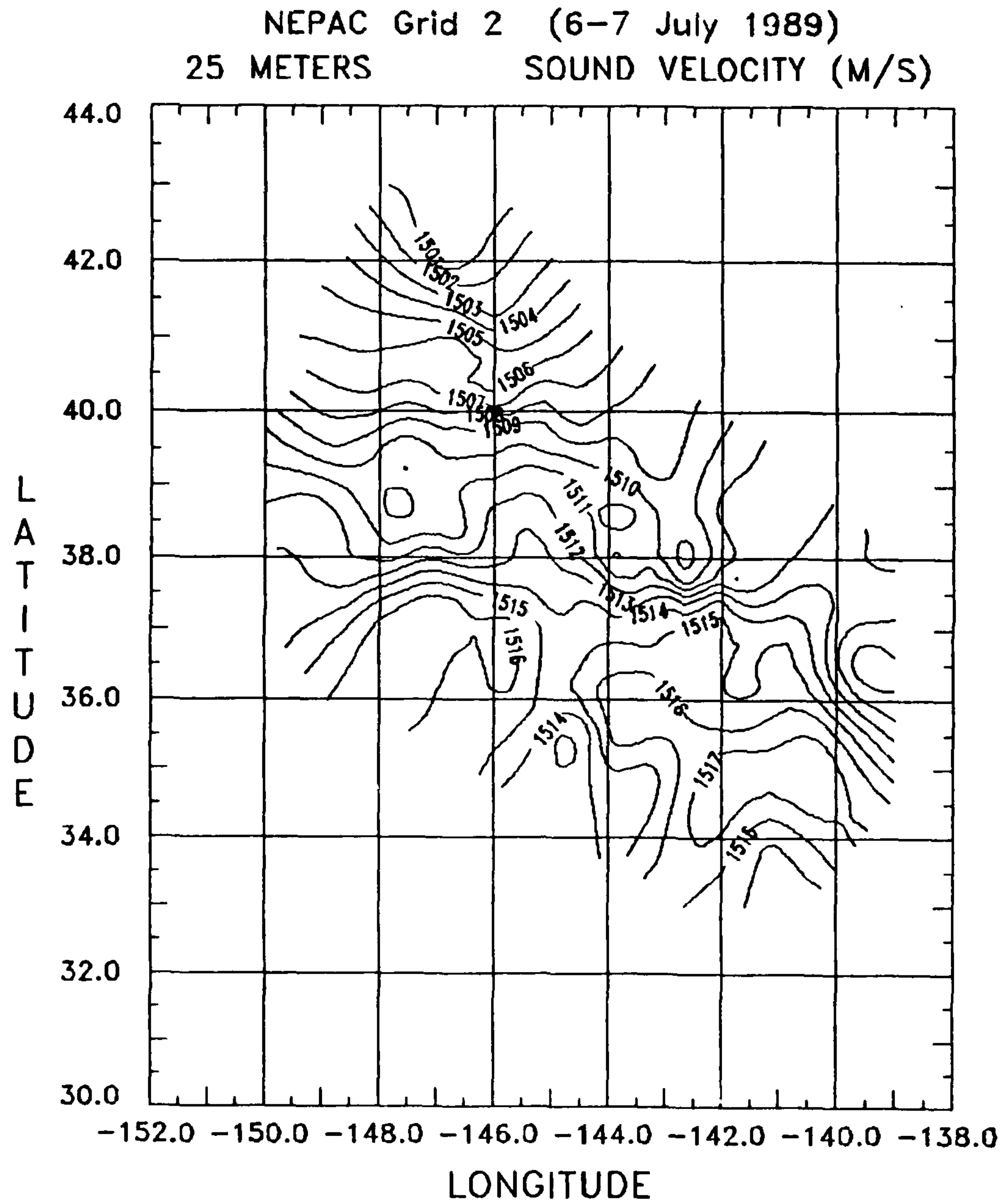
NOARL Code 331

NEPAC Grid 2 (6–7 July 1989)
0 METERS SOUND VELOCITY (M/S)



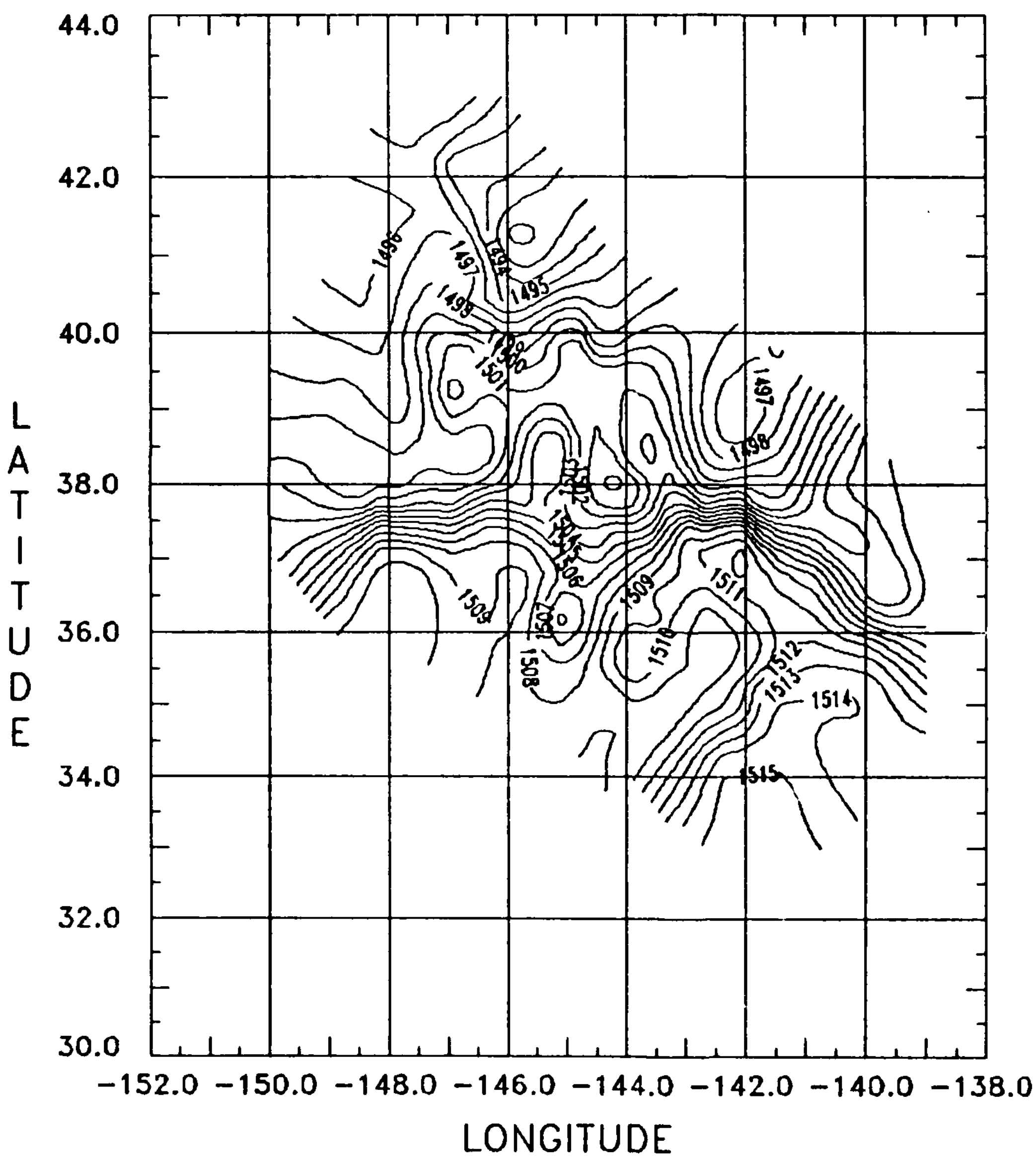
NOARL Code 331

12:47:15 4/17/90 dx=.3 ,dy=.3



NOARL Code 331

NEPAC Grid 2 (6–7 July 1989)
50 METERS SOUND VELOCITY (M/S)



NOARL Code 331

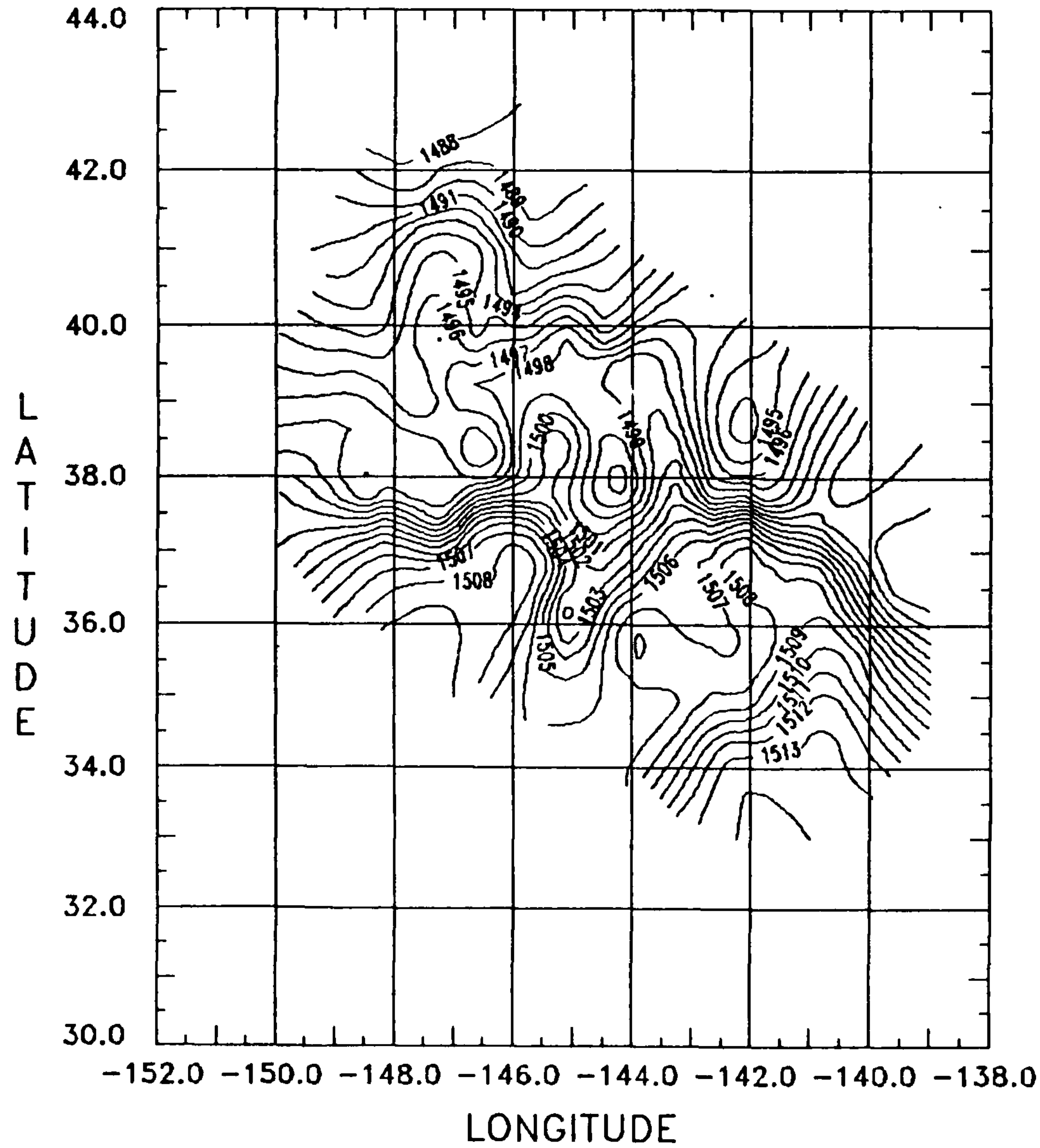
12:53:52

4/17/90

dx=.3 .dy=.3

NEPAC Grid 2 (6–7 July 1989)

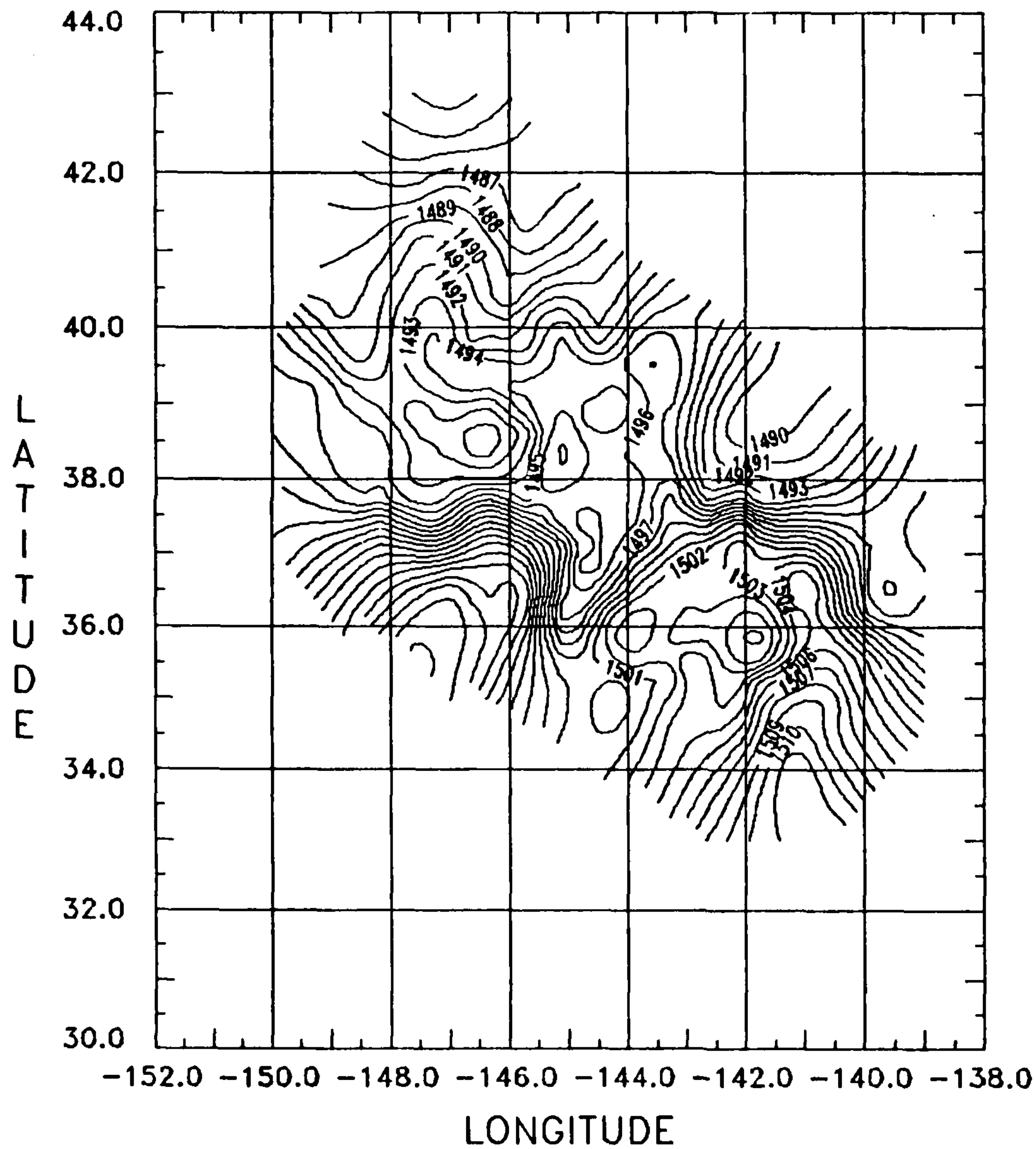
75 METERS SOUND VELOCITY (M/S)



NOARL Code 331

12:55:02 4/17/90 dx=.3 .dy=.3

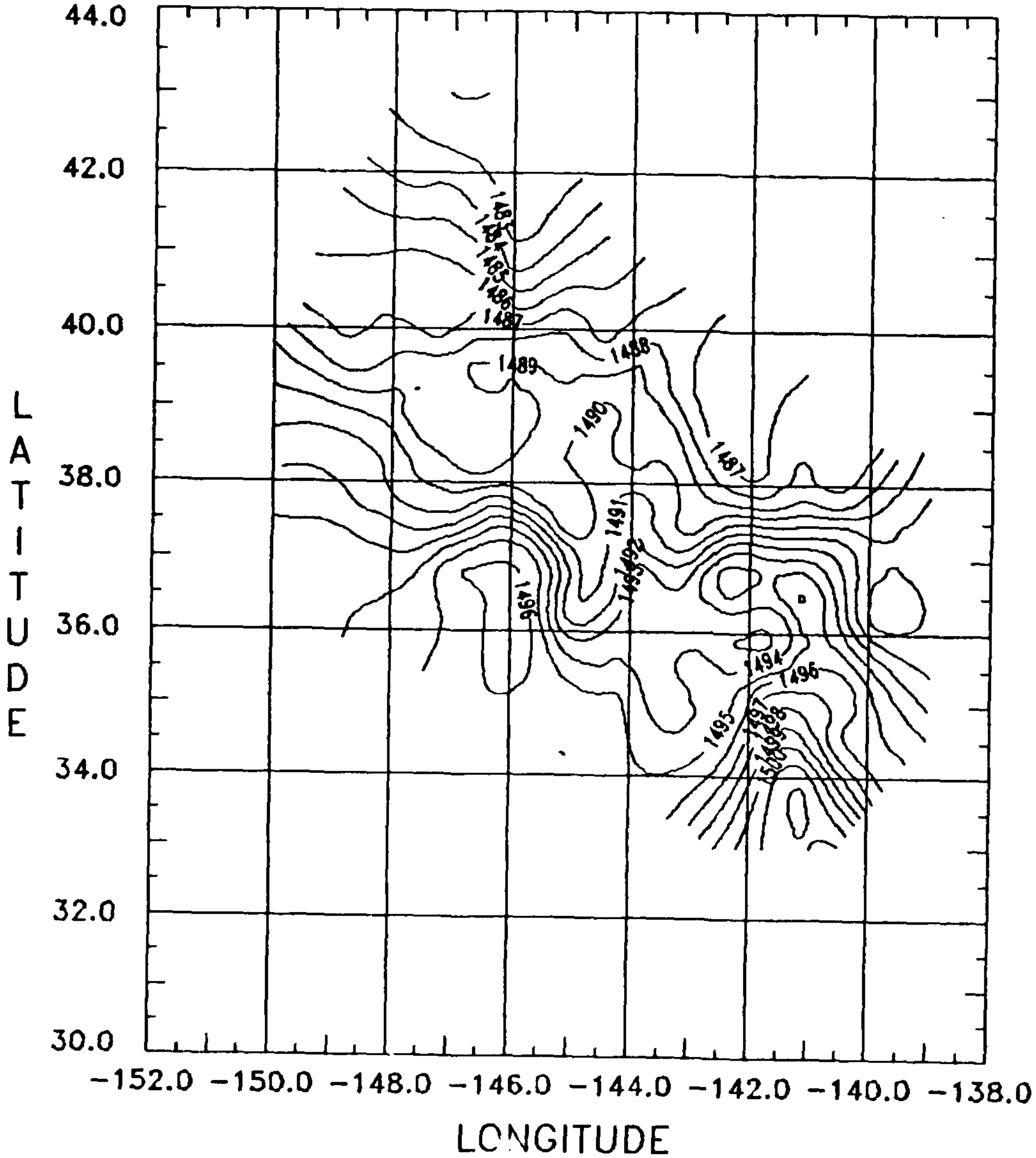
NEPAC Grid 2 (6–7 July 1989)
100 METERS SOUND VELOCITY (M/S)



NOARL Code 331

12:56:14 4/17/90 dx=.3 .dy=.3

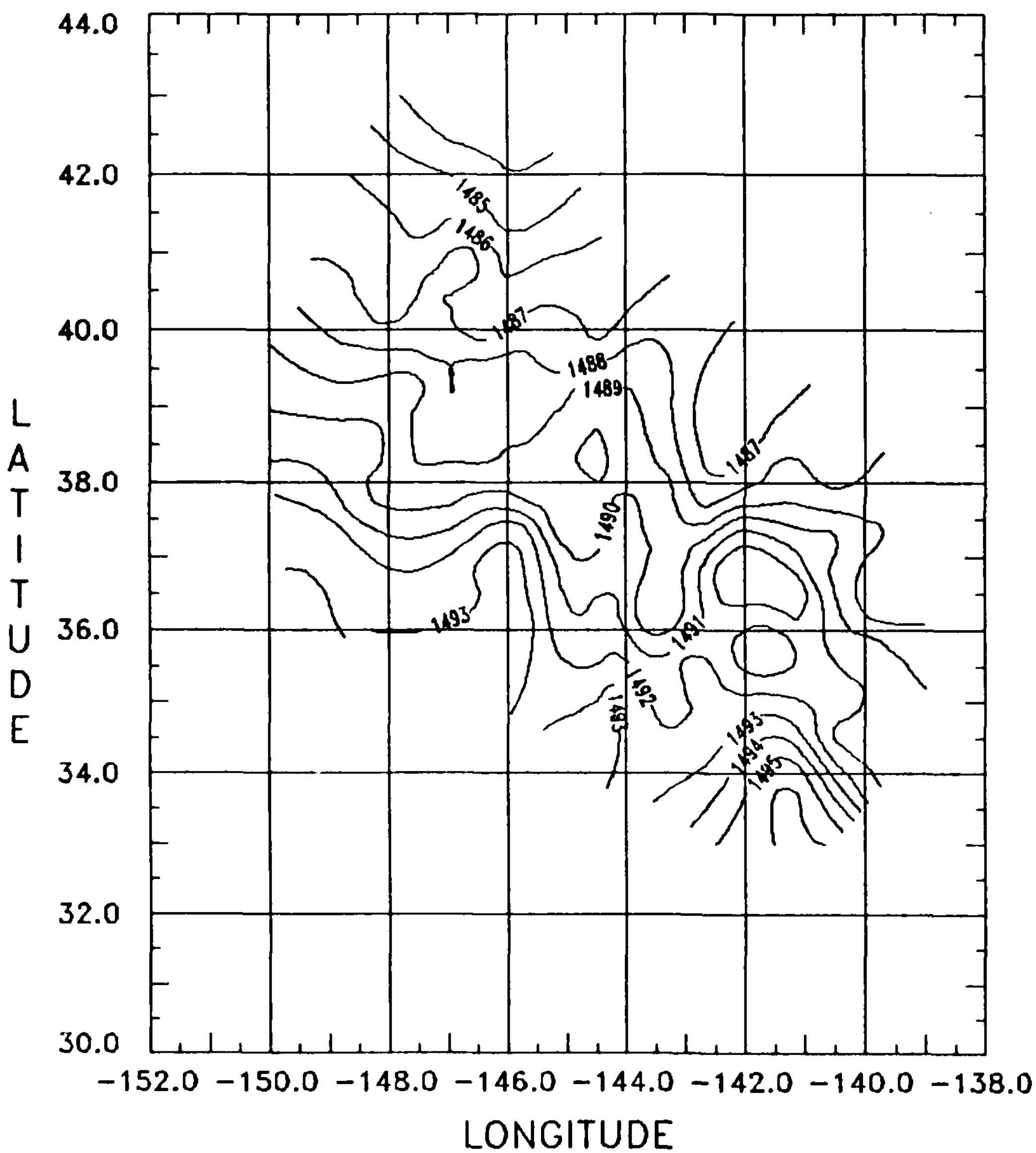
NEPAC Grid 2 (6–7 July 1989)
150 METERS SOUND VELOCITY (M/S)



NOARL Code 331

12:57:22 4/17/90 dx=.3 .dy=.3

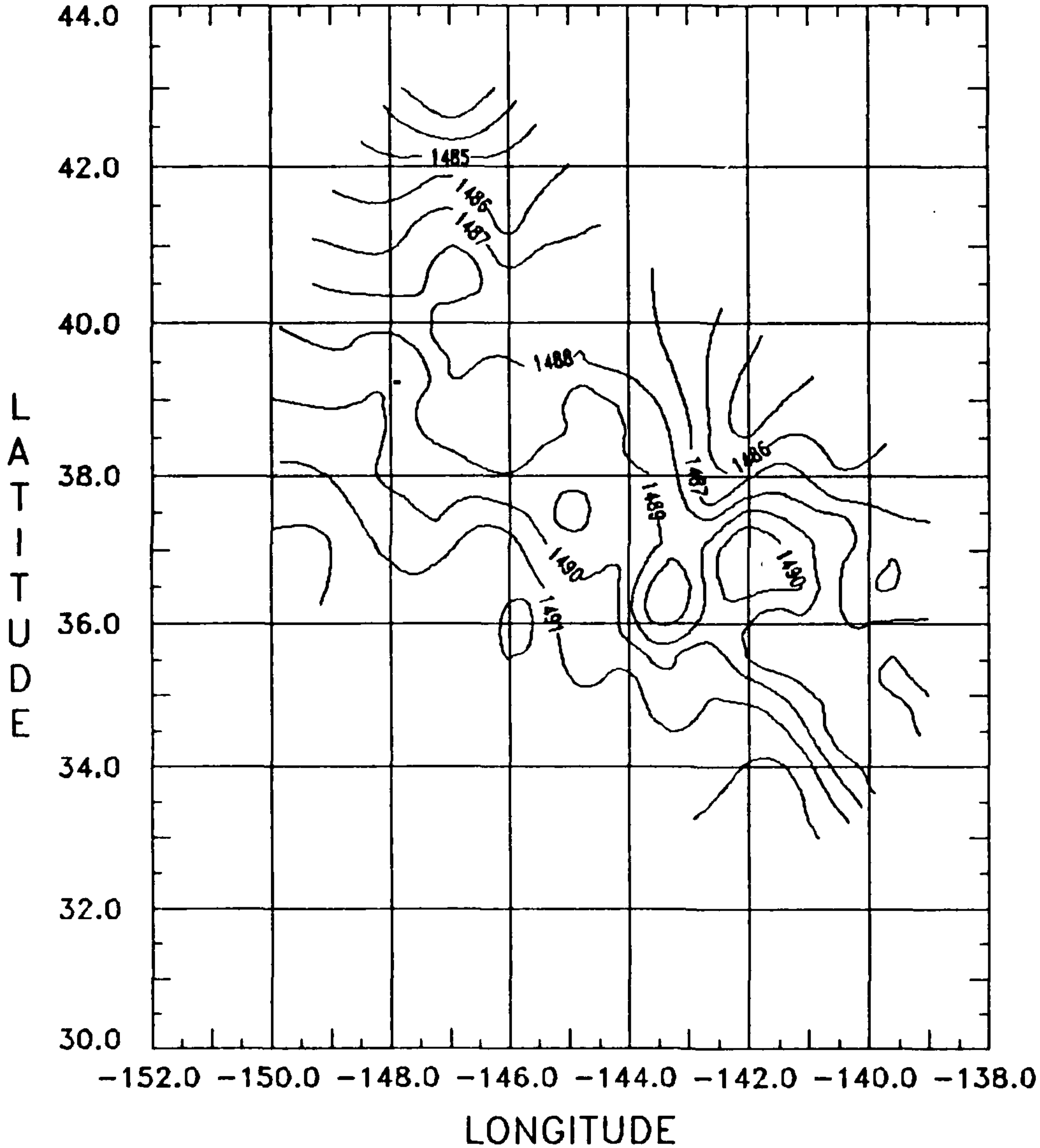
NEPAC Grid 2 (6–7 July 1989)
200 METERS SOUND VELOCITY (M/S)



NOARL Code 331

12:58:16 4/17/90 dx=.3 ,dy=.3

NEPAC Grid 2 (6–7 July 1989)
250 METERS SOUND VELOCITY (M/S)

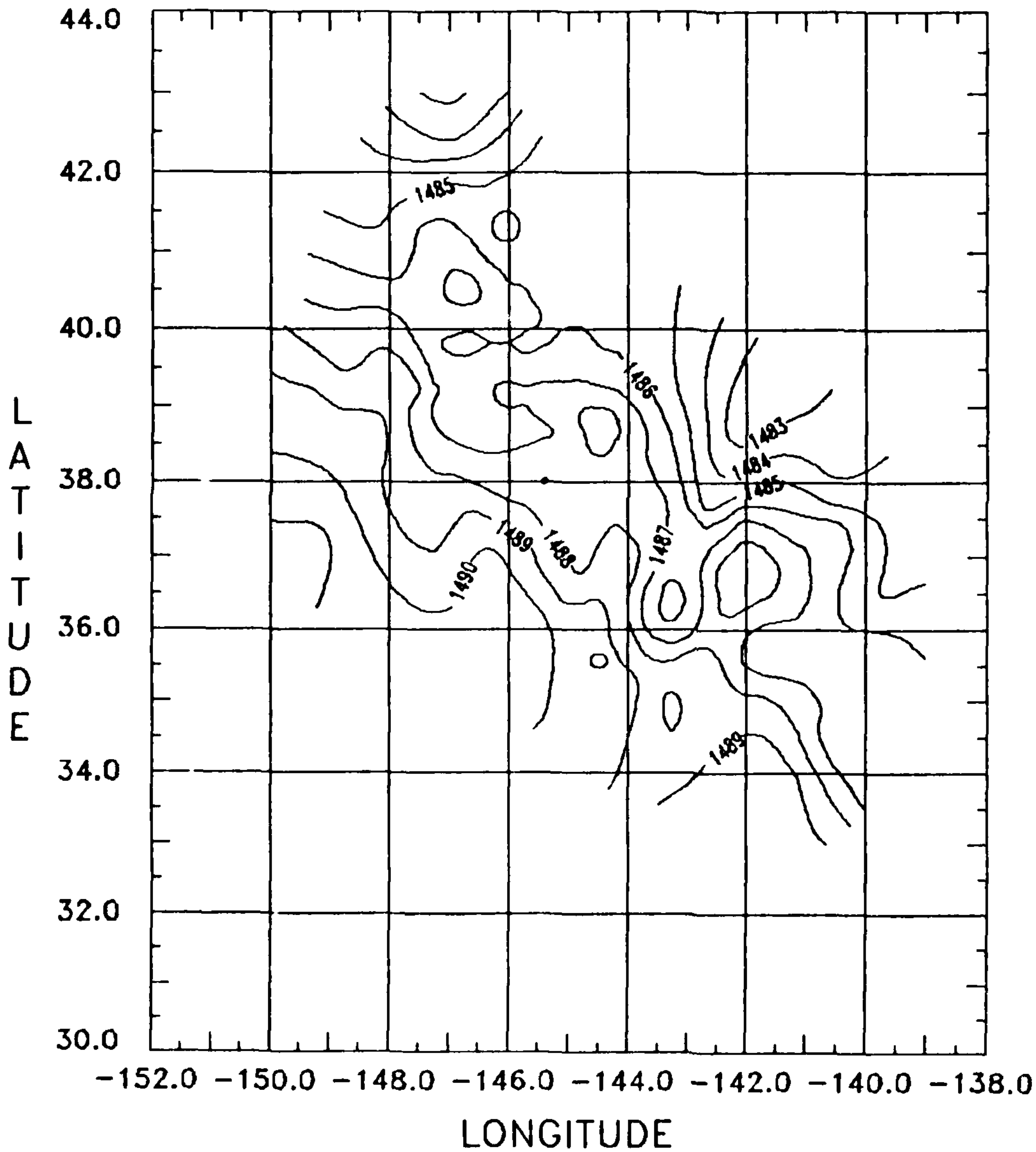


NOARL Code 331

12:59:06 4/17/90 dx=.3 .dy=.3

NEPAC Grid 2 (6–7 July 1989)

300 METERS SOUND VELOCITY (M/S)



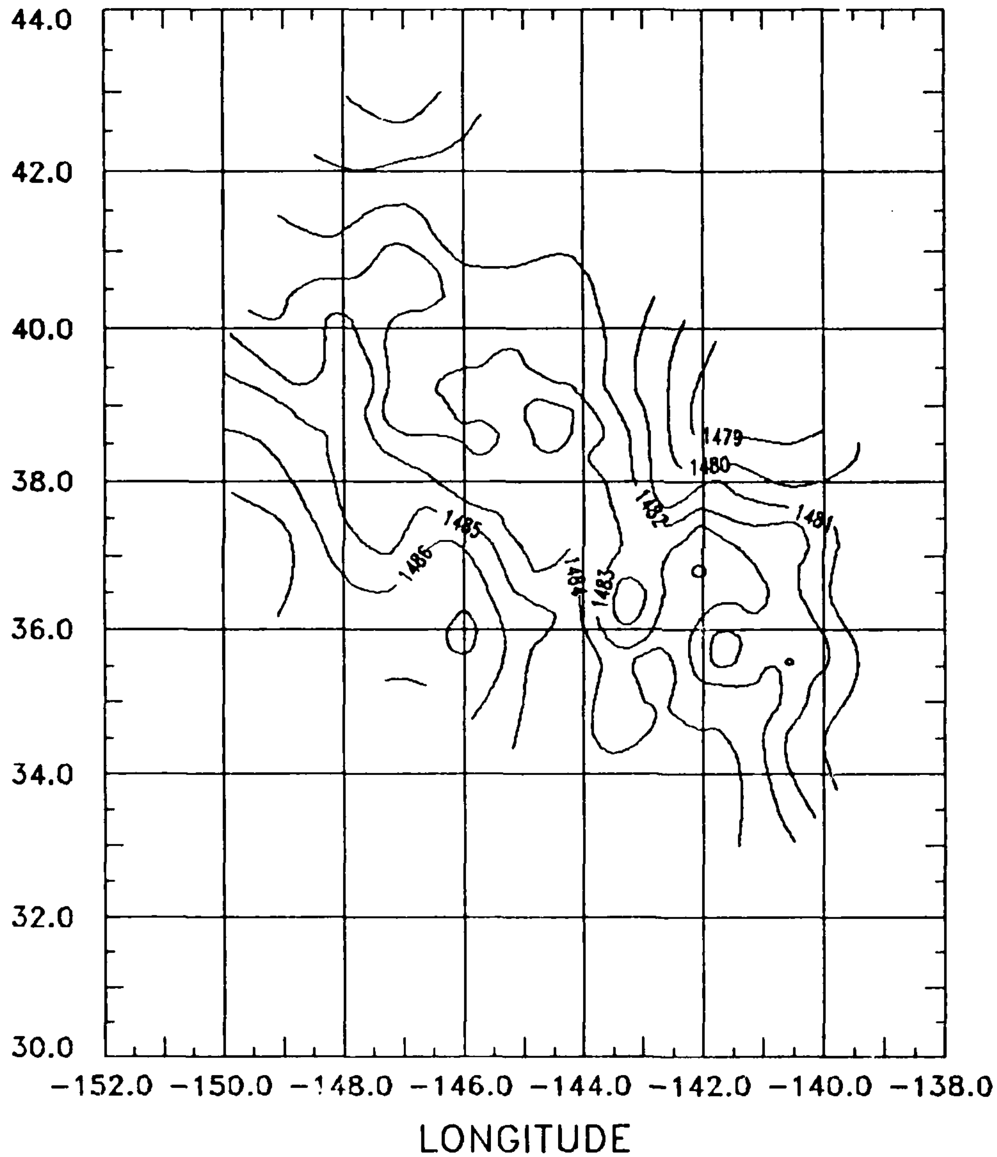
NOARL Code 331

12:59:55

4/17/90

dx=.3 .dy=.3

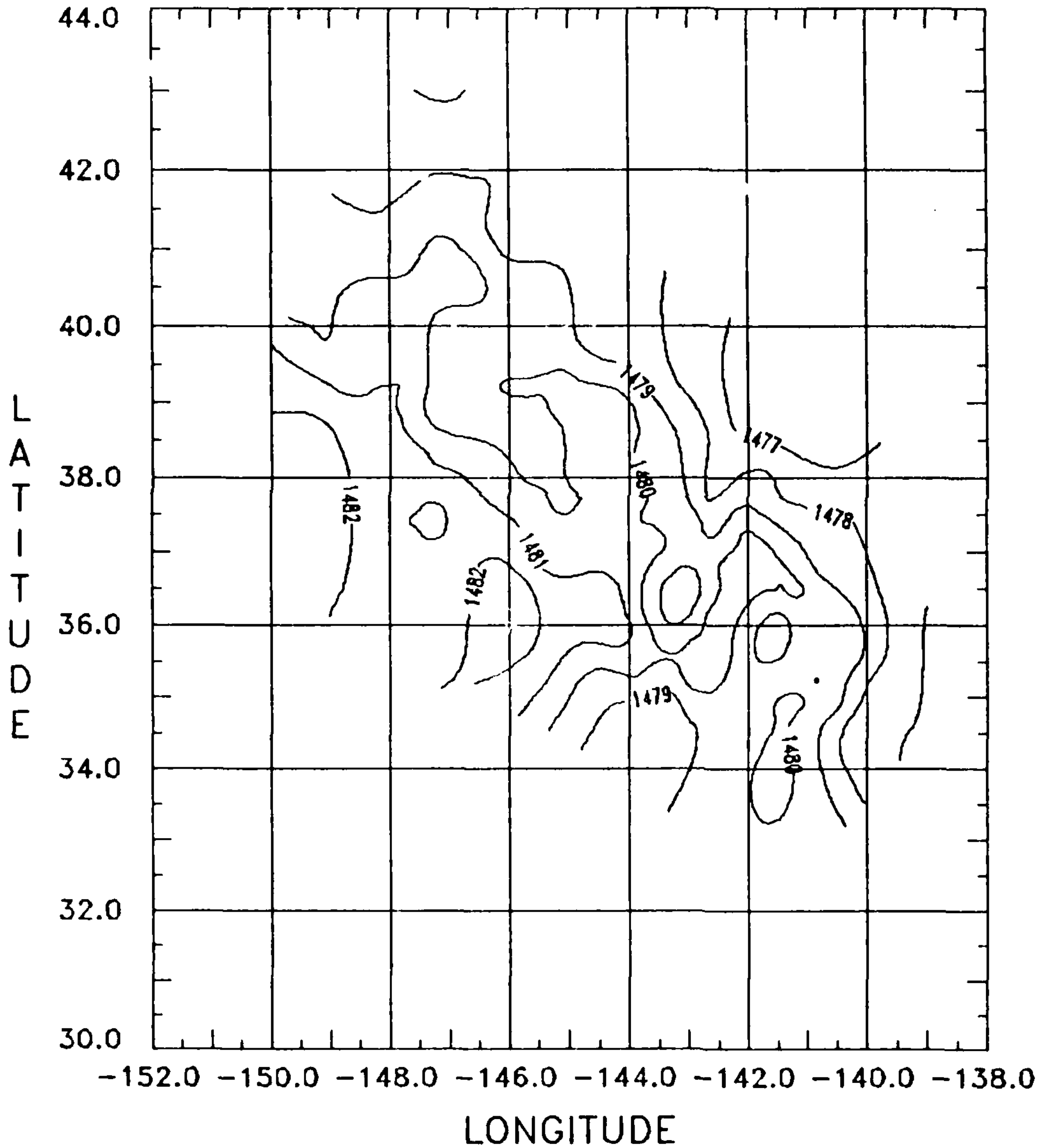
NEPAC Grid 2 (6–7 July 1989)
400 METERS SOUND VELOCITY (M/S)



NOARL Code 331

13:00:44 4/17/90 dx=.3 .dy=.3

NEPAC Grid 2 (6–7 July 1989)
500 METERS SOUND VELOCITY (M/S)

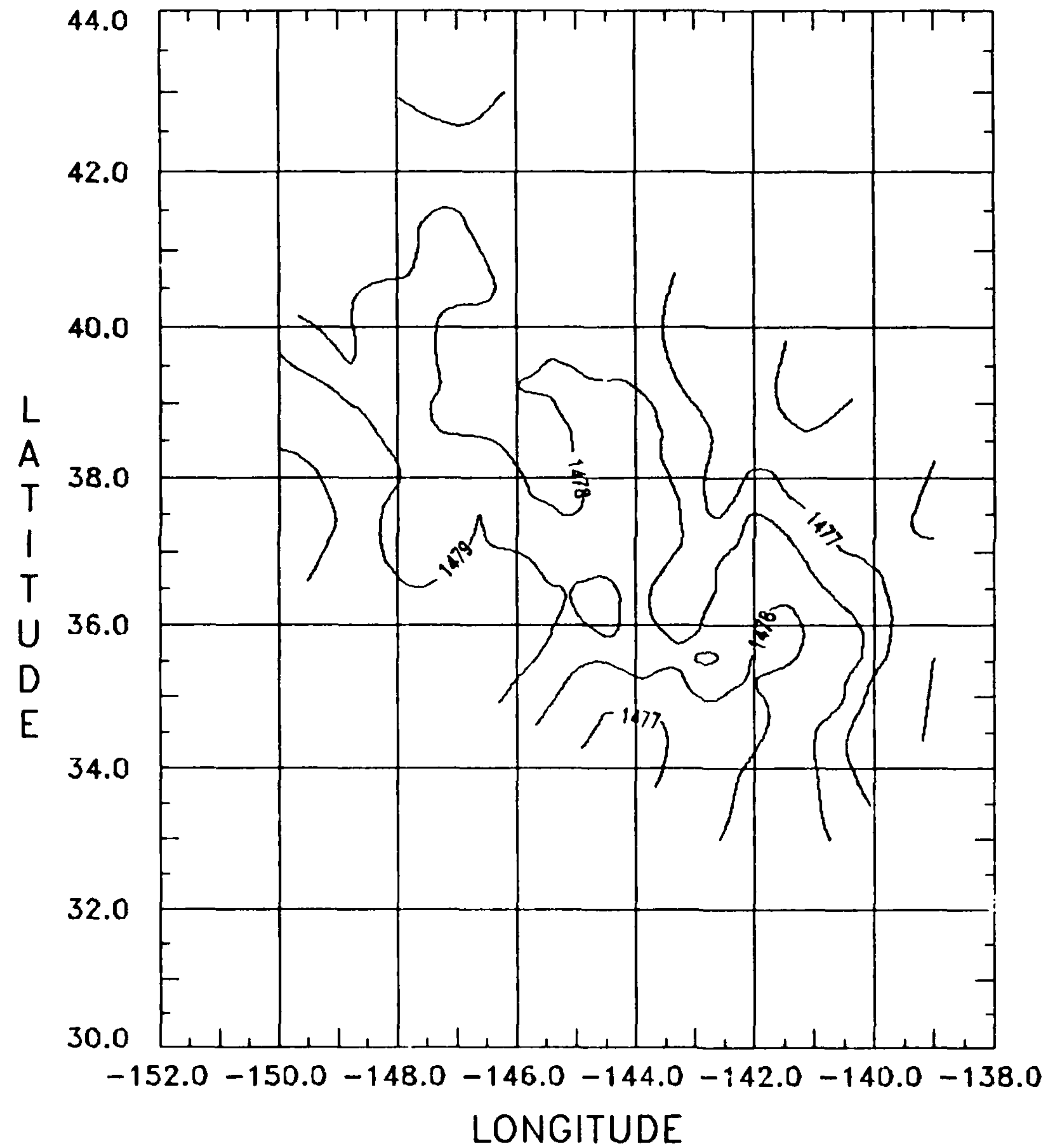


NOARL Code 331

13:01:32 4/17/90 dx=.3 ,dy=.3

NEPAC Grid 2 (6-7 July 1989)

600 METERS SOUND VELOCITY (M/S)



NOARL Code 331

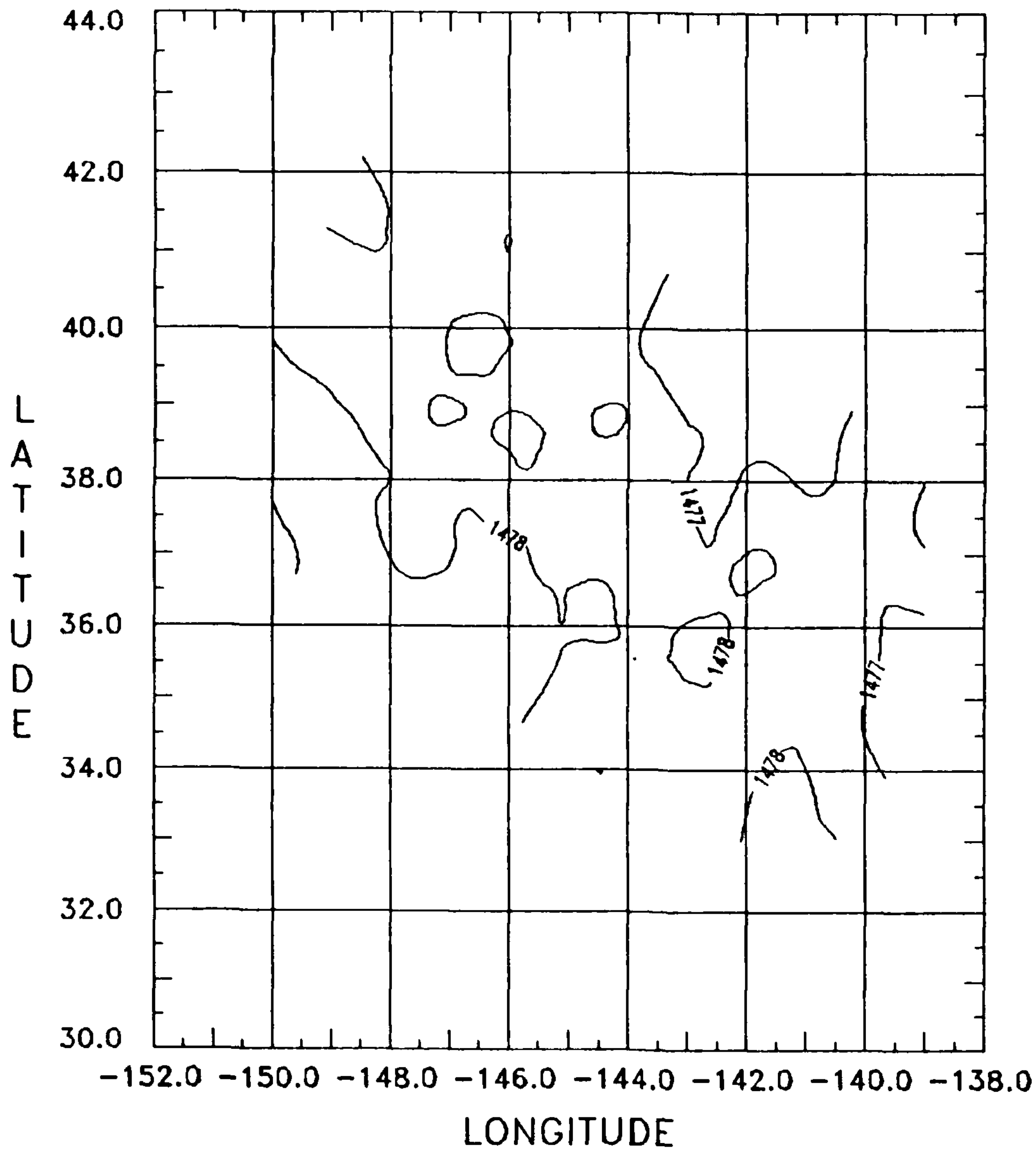
13:02:17

4/17/90

dx=.3 .dy=.3

NEPAC Grid 2 (6–7 July 1989)

700 METERS SOUND VELOCITY (M/S)



NOARL Code 331

13:02:58 4/17/90 dx=.3 .dy=.3

Appendix E.

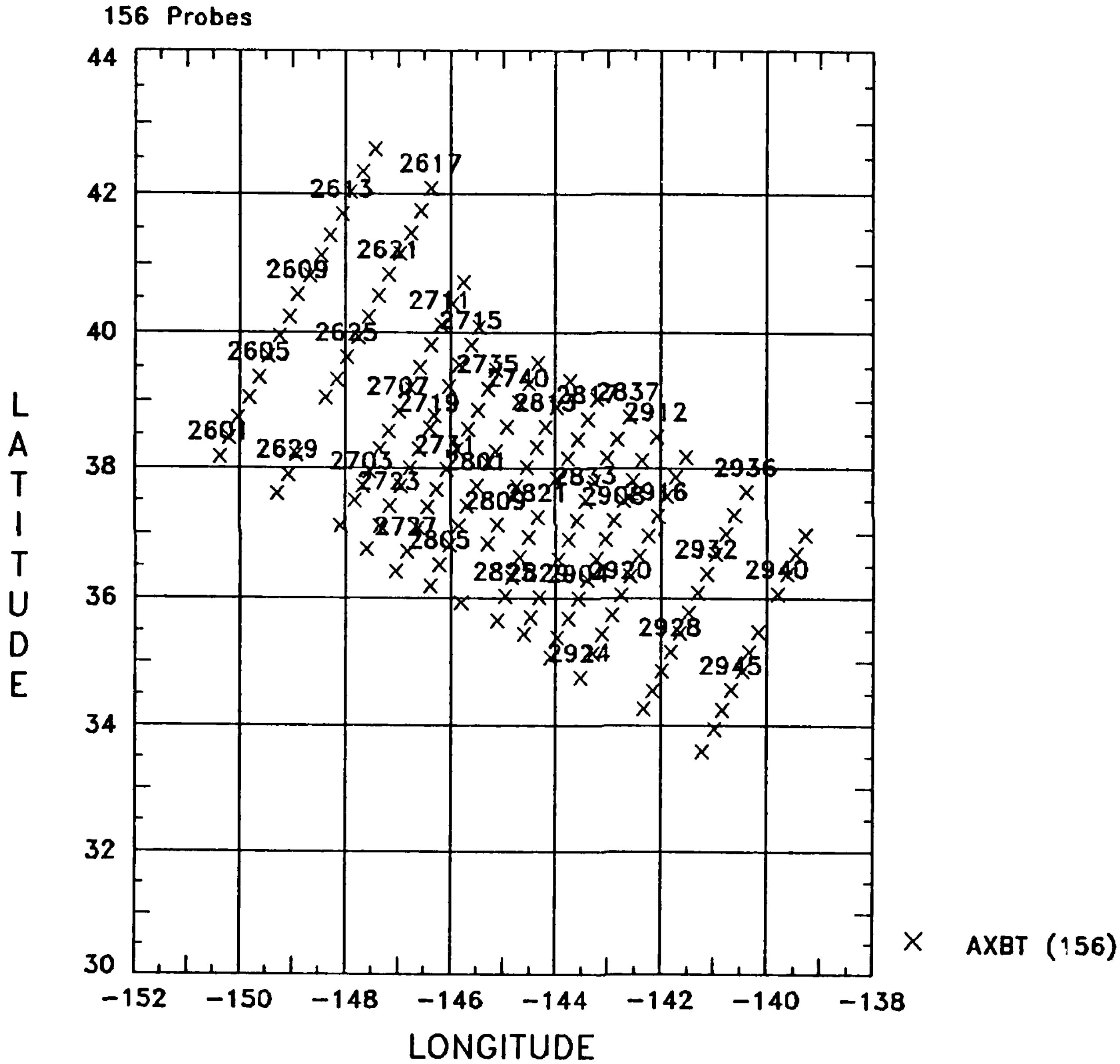
NEPAC Grid 3 (17 - 19 July 1989)

Temperature Contours at Selected Depths

9:01:40

5/09/90

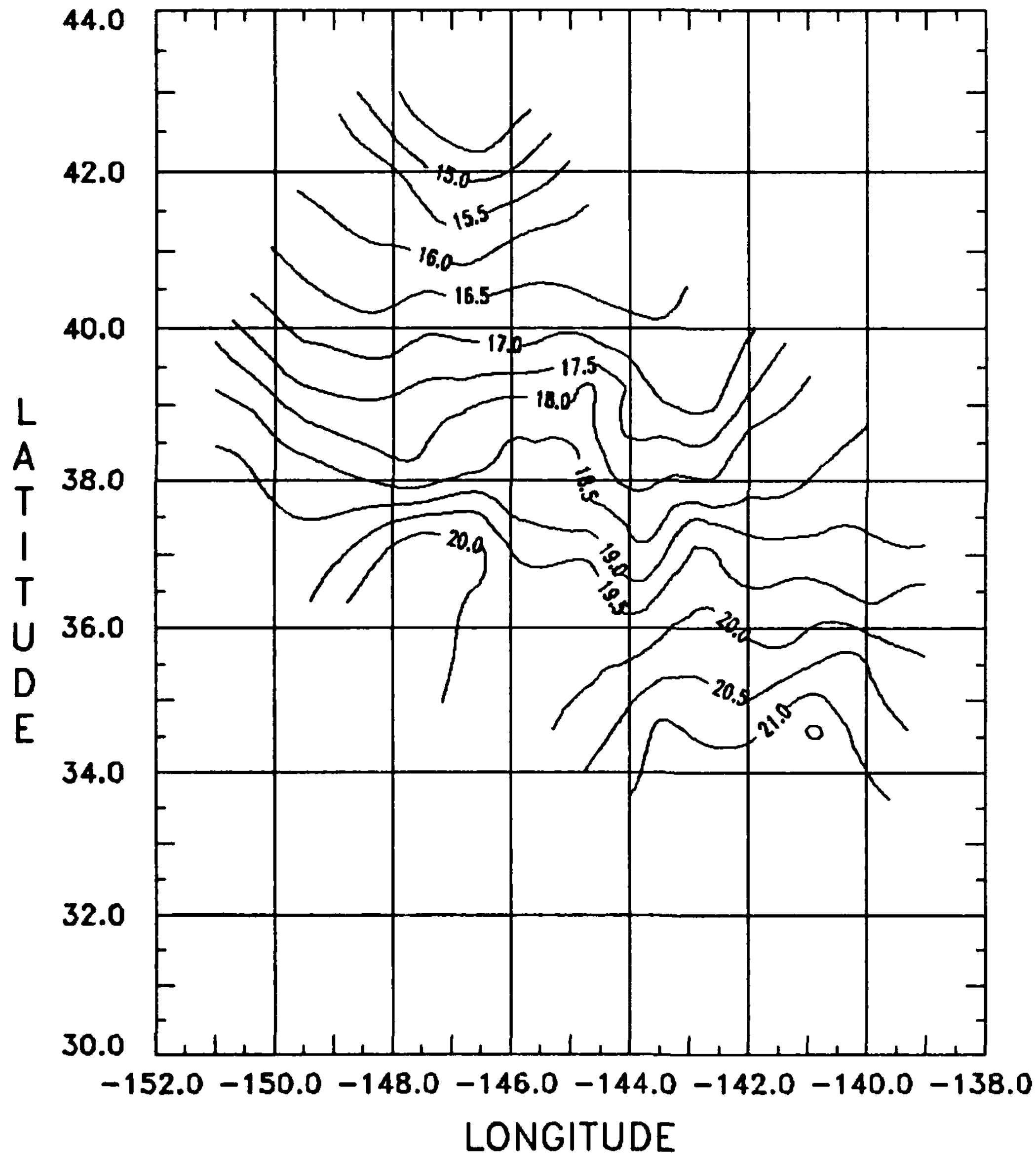
NEPAC Grid 3 (17–19 July 1989)



NOARL Code 331

NEPAC Grid 3

0 METERS TEMPERATURE (DEG C)



NOARL Code 331

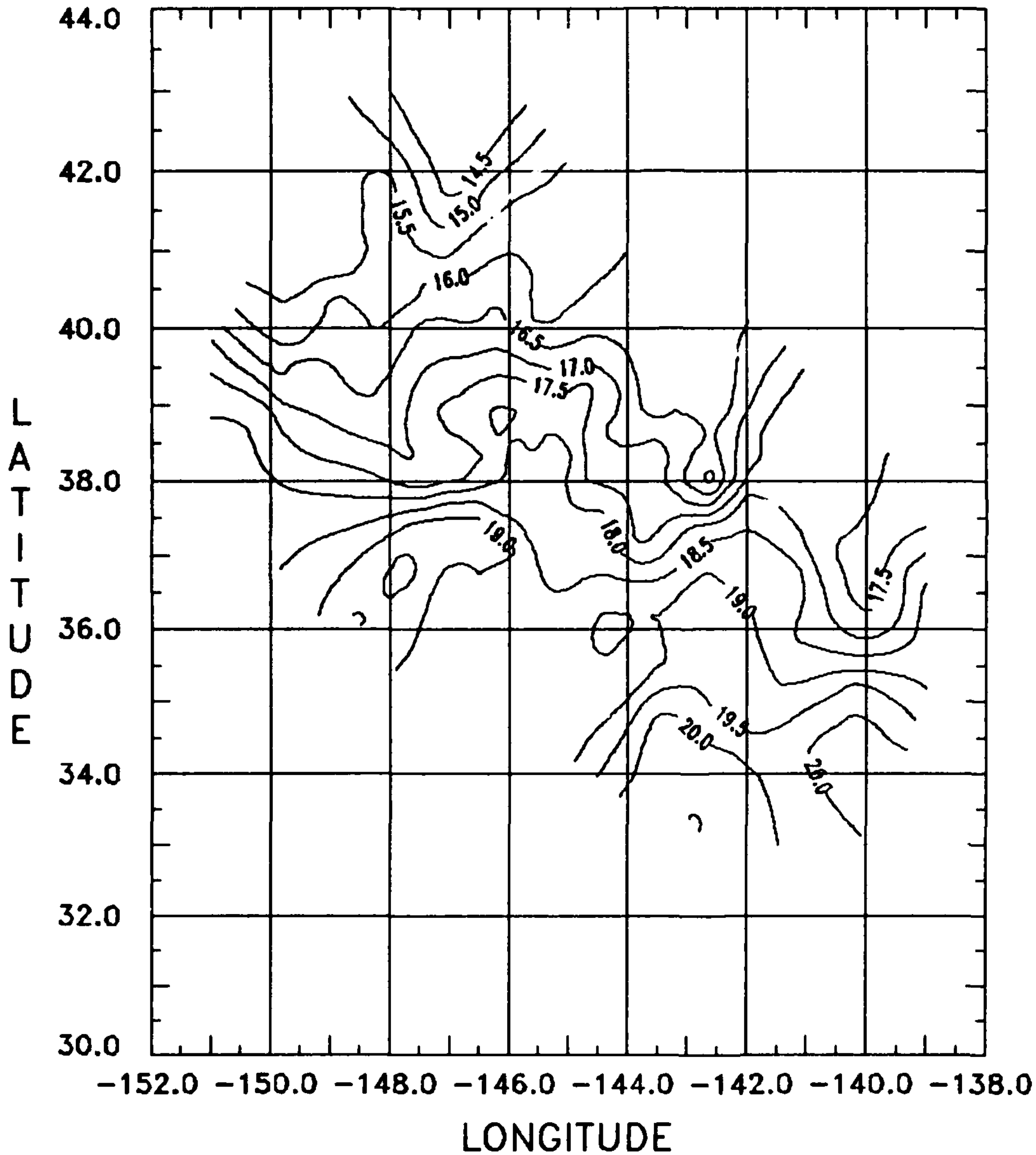
7:53:56

2/12/90

dx=.3 .dy=.3

NEPAC Grid 3

25 METERS TEMPERATURE (DEG C)

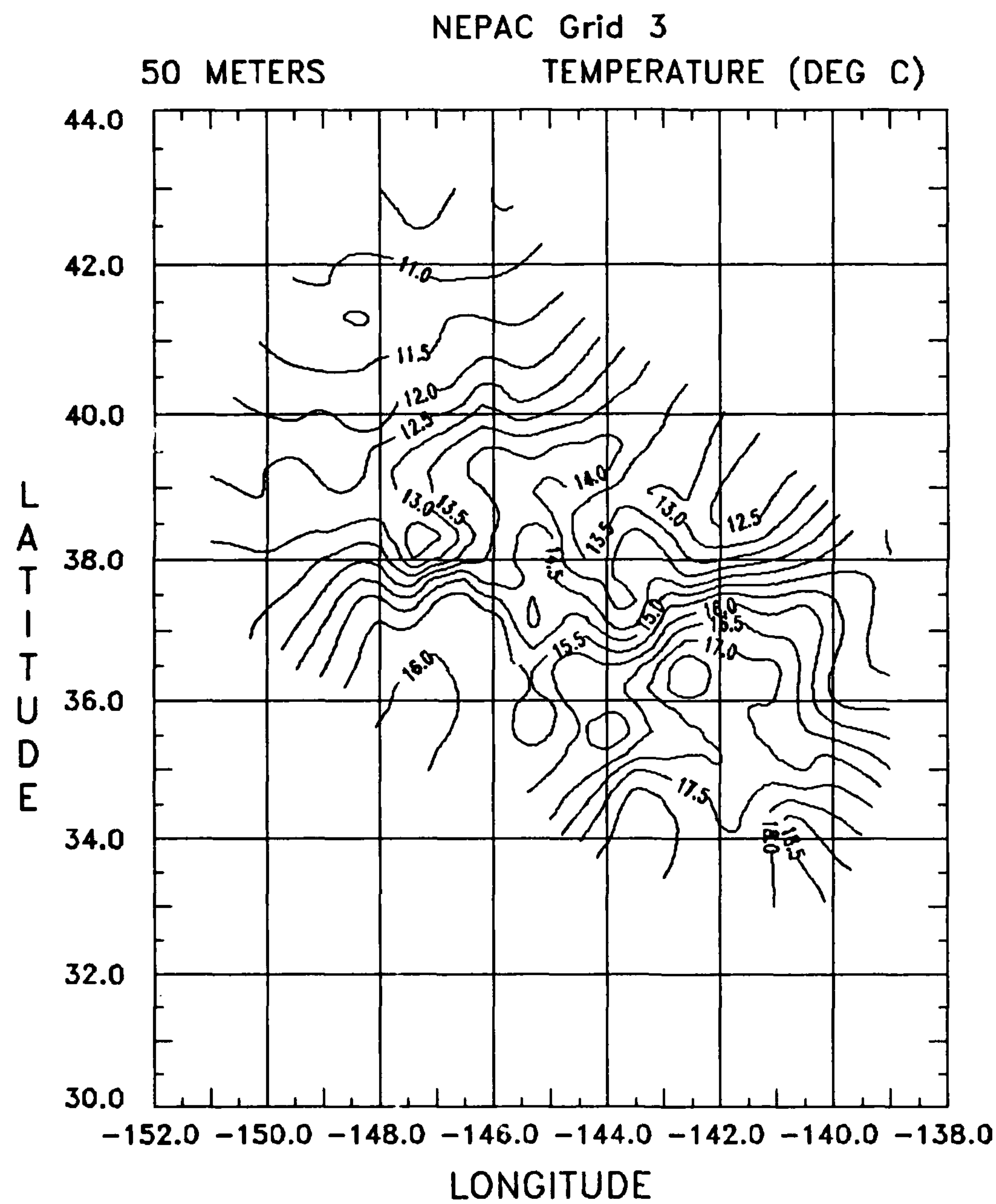


NOARL Code 331

7:54:52

2/12/90

dx=.3 .dy=.3

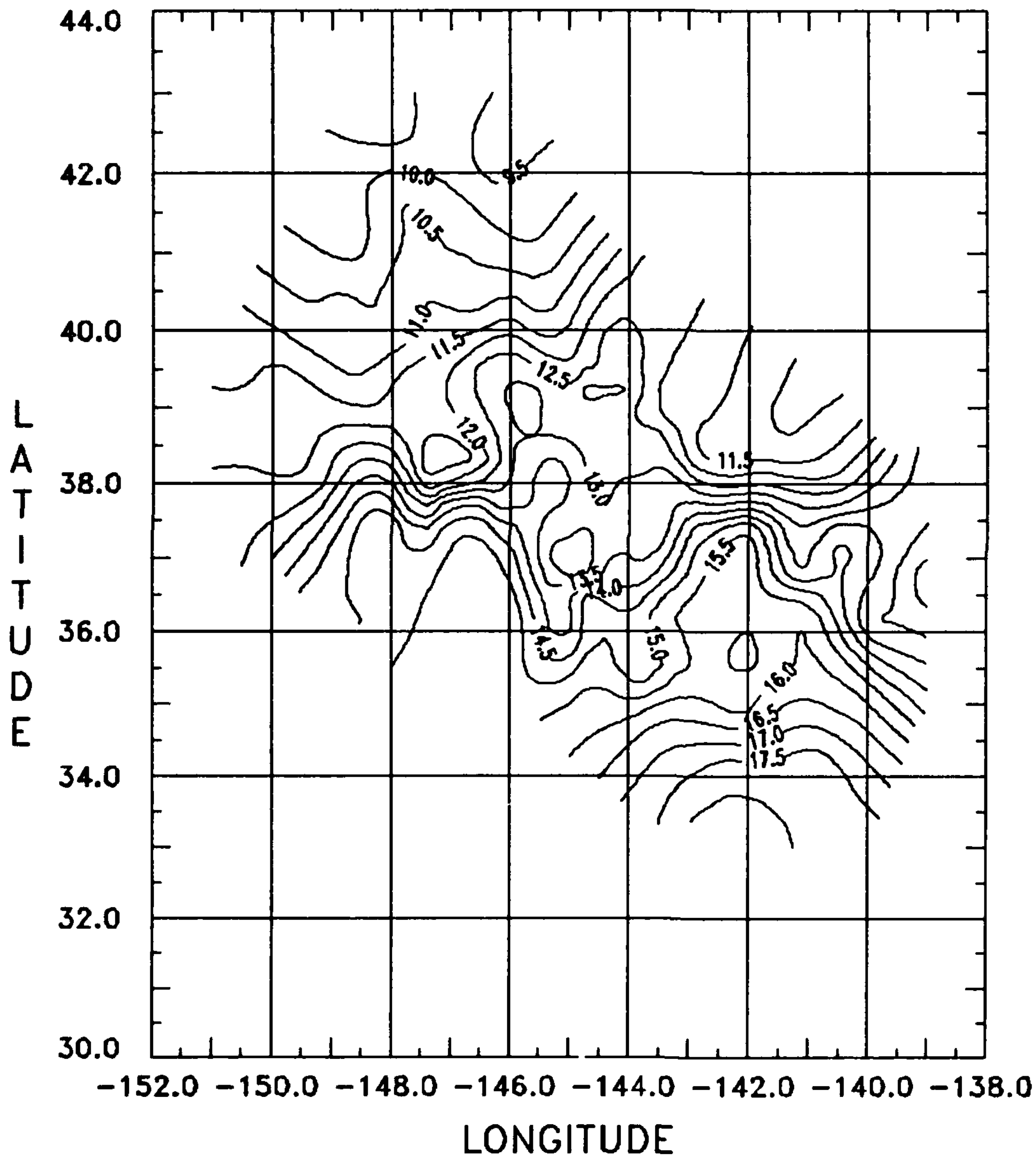


7:55:51 2/12/90 dx=.3 .dy=.3

NOARL Code 331

NEPAC Grid 3

75 METERS TEMPERATURE (DEG C)

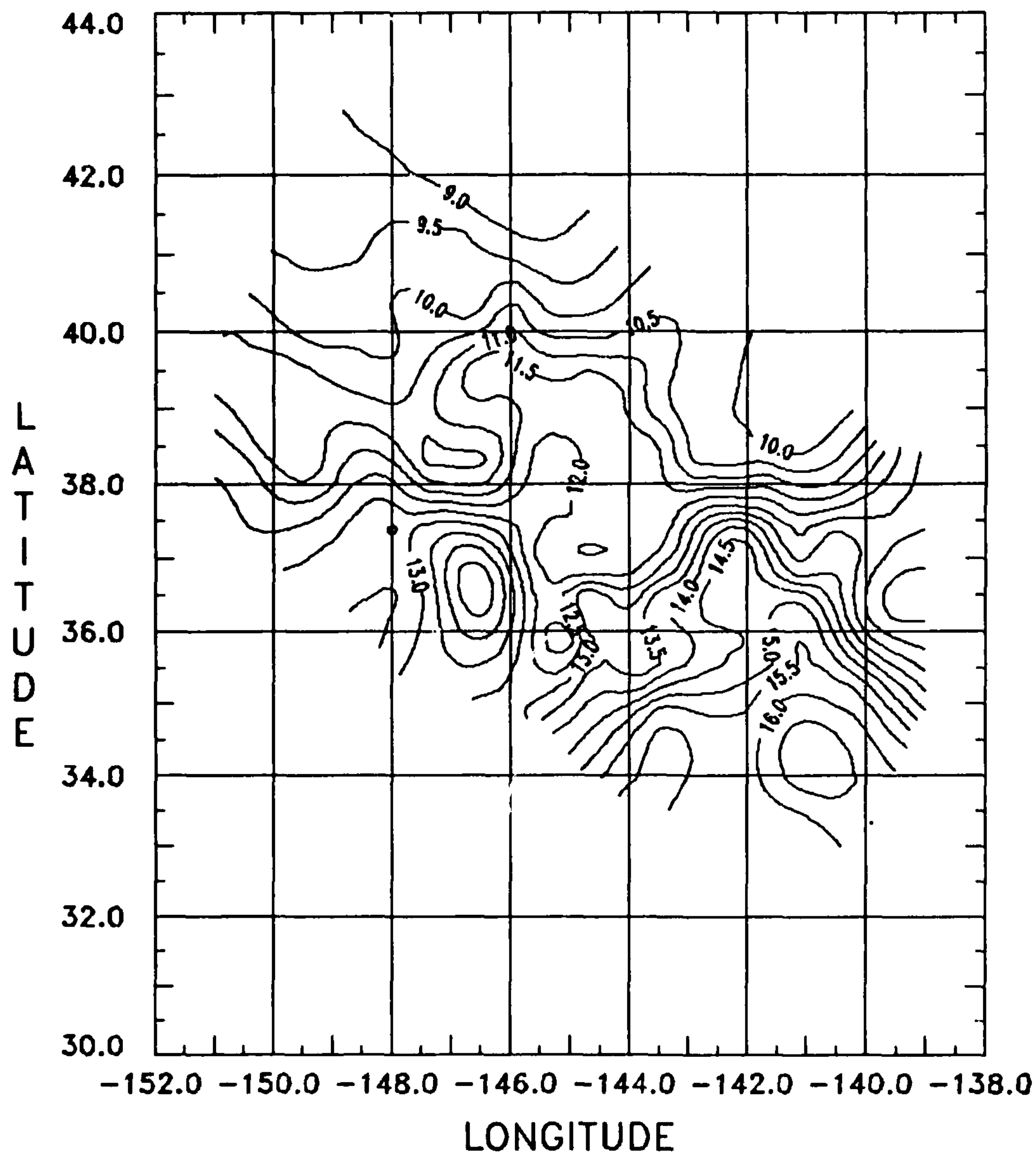


NOARL Code 331

7:56:51 2/12/90 dx=.3 .dy=.3

NEPAC Grid 3

100 METERS TEMPERATURE (DEG C)



NOARL Code 331

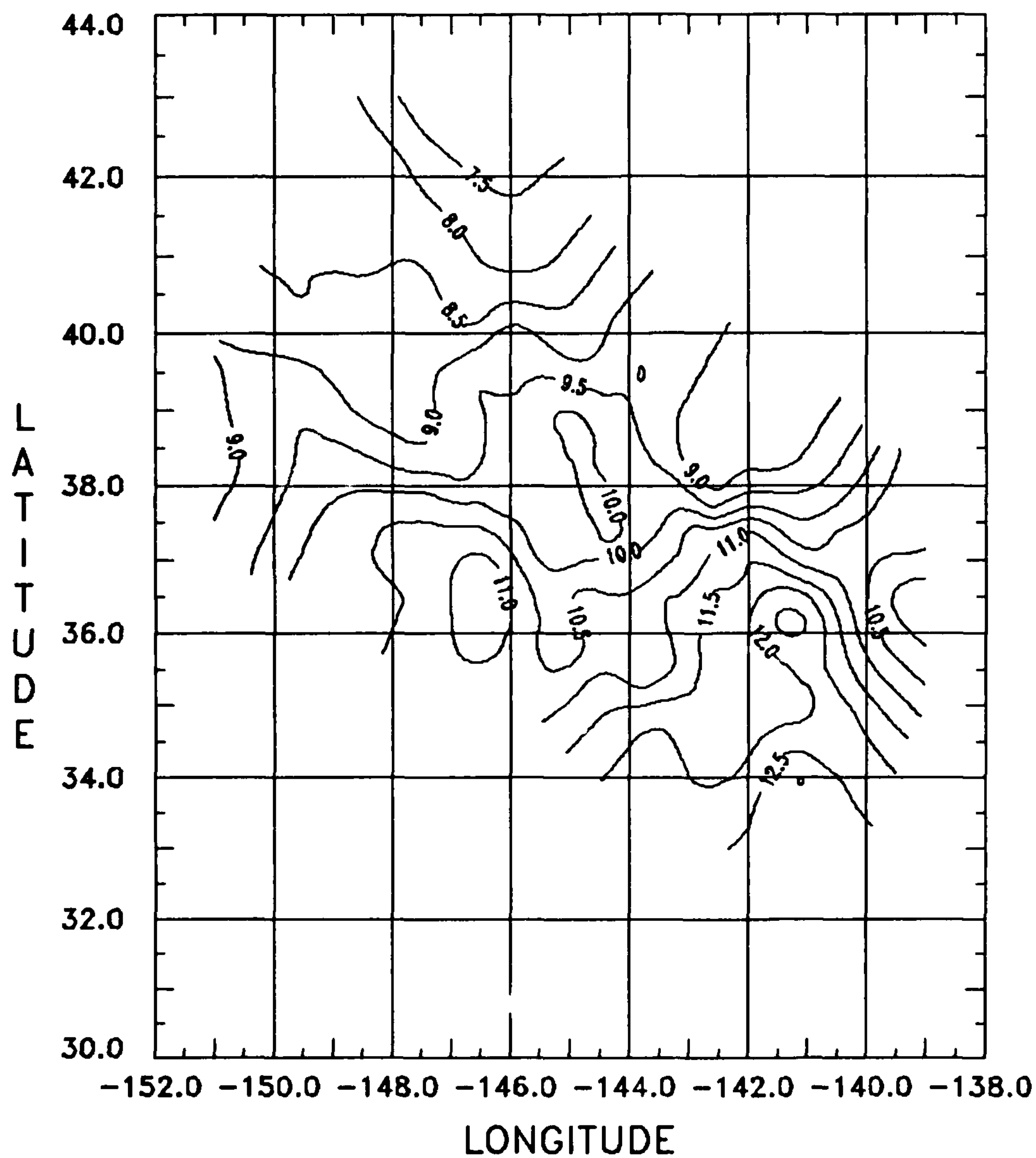
8:15:54

2/12/90

dx=.3 .dy=.3

NEPAC Grid 3

150 METERS TEMPERATURE (DEG C)

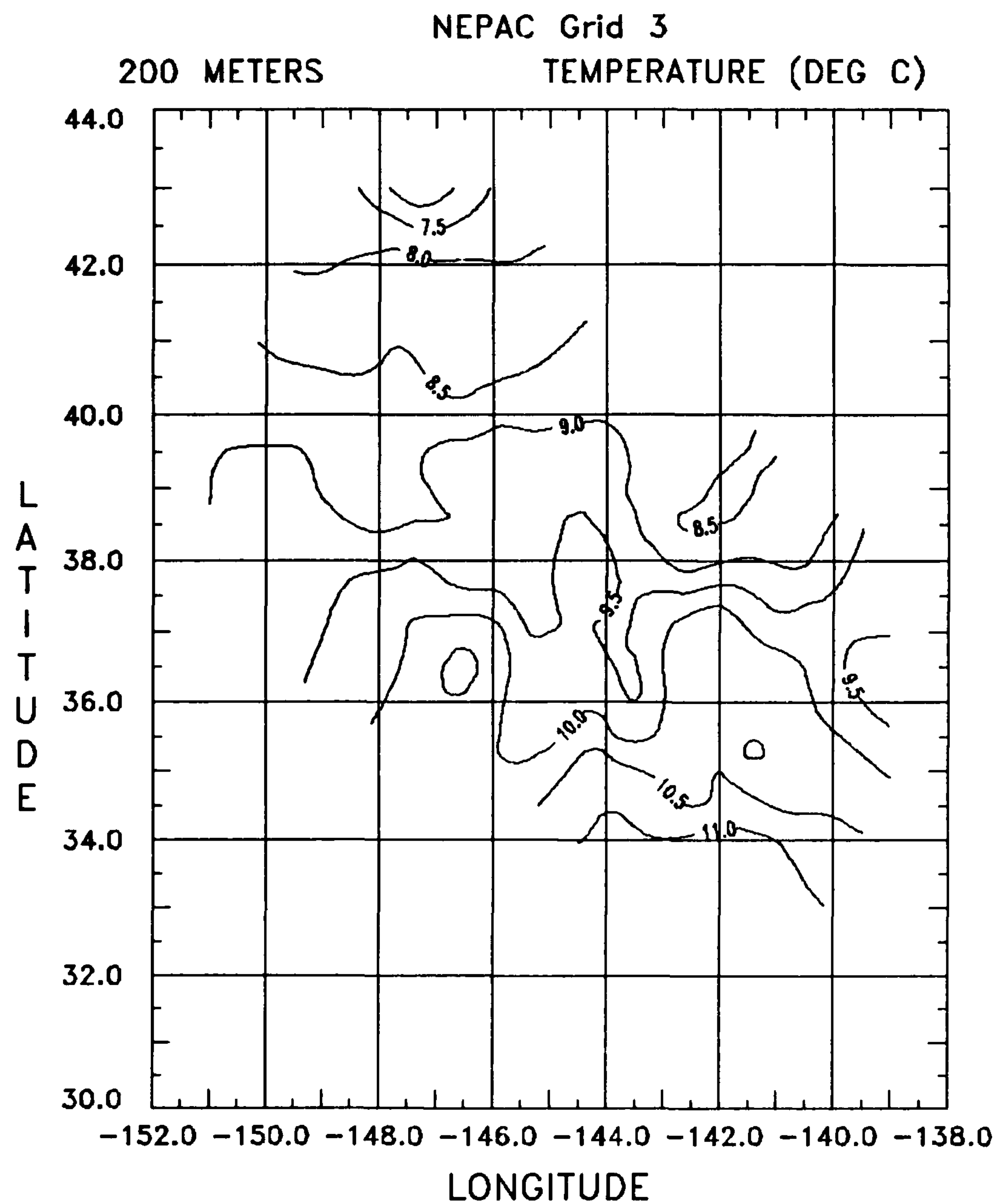


NOARL Code 331

7:59:27

2/12/90

dx=.3 ,dy=.3

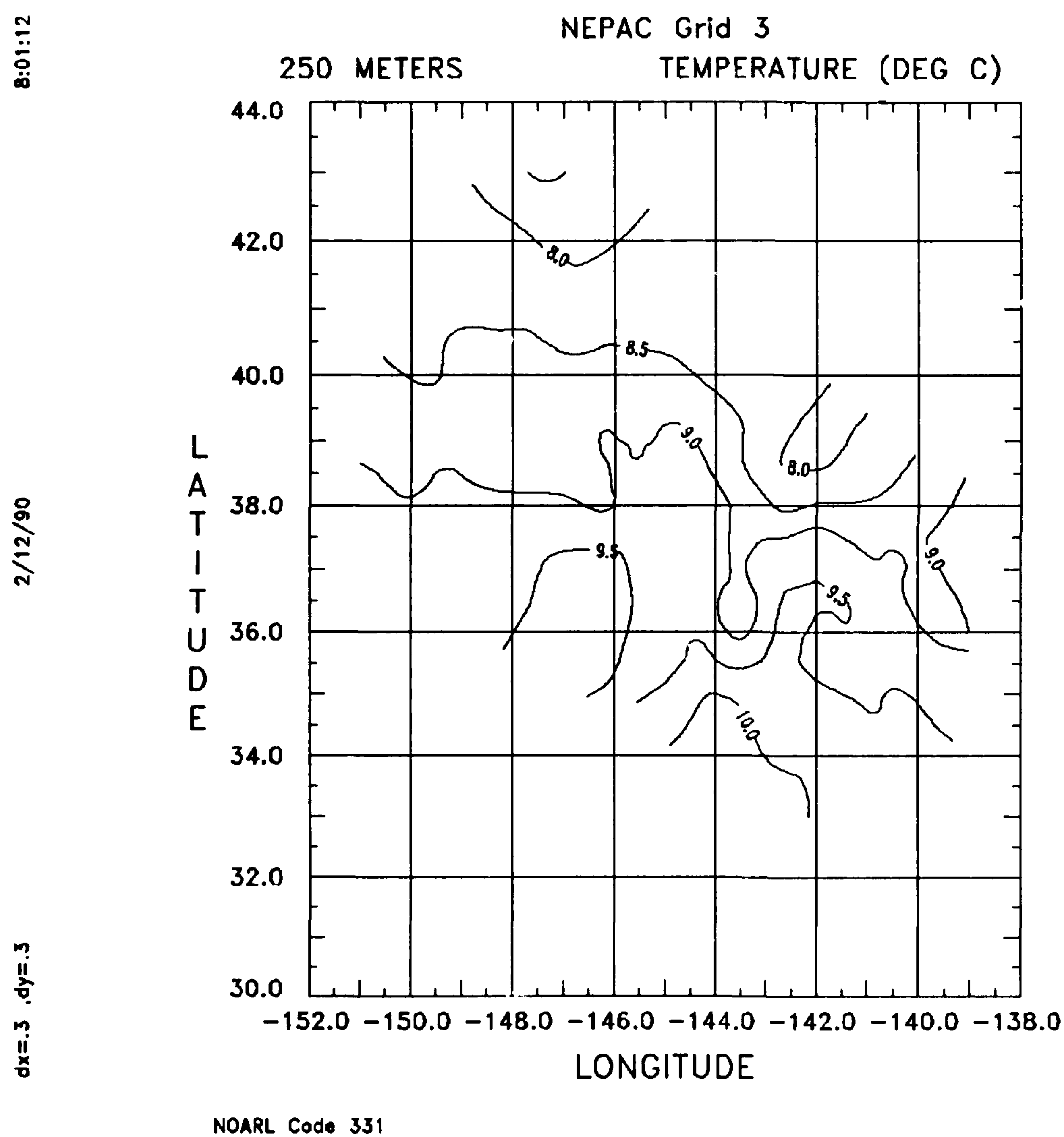


8:00:20

2/12/90

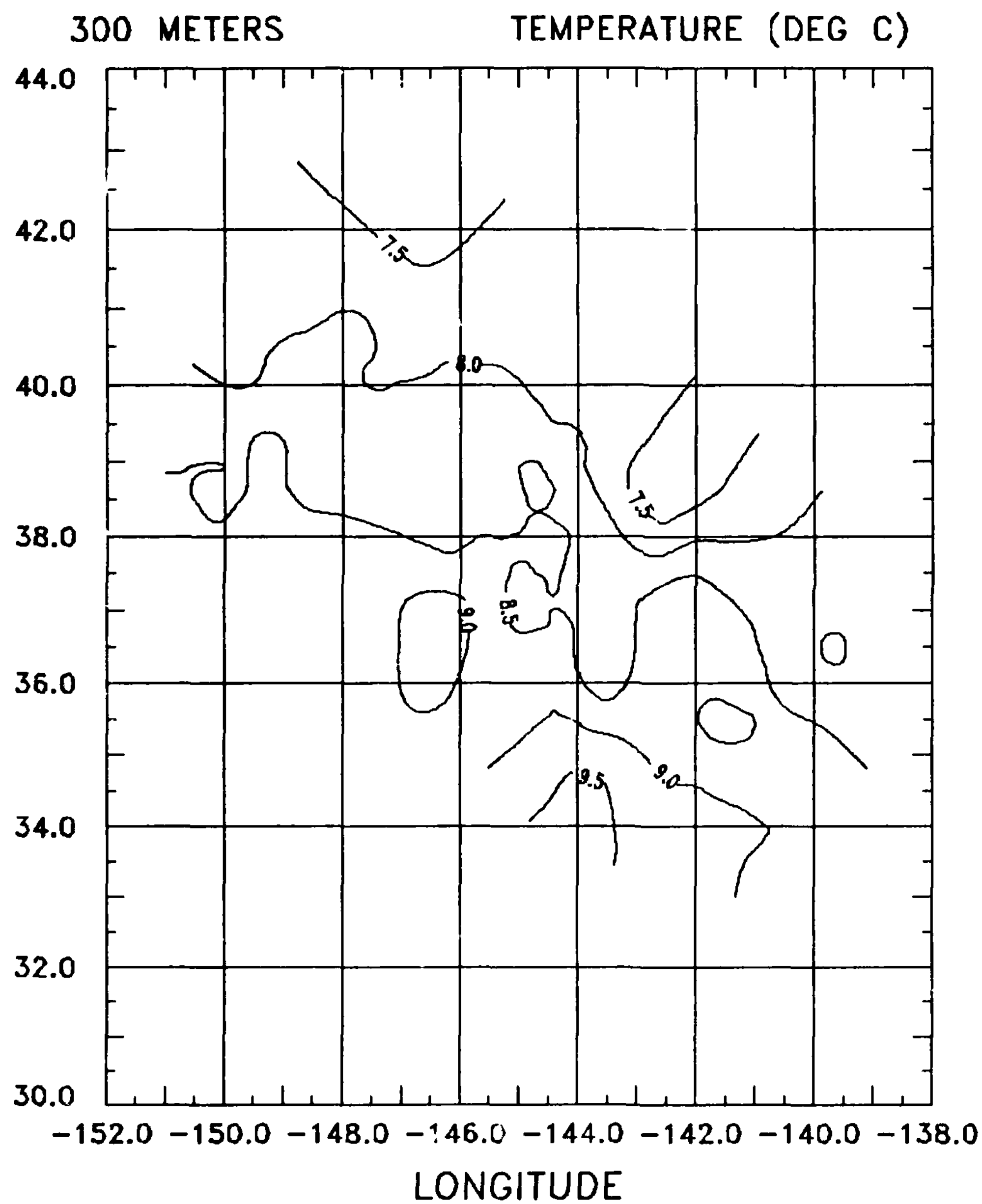
dx=.3 ,dy=.3

NOARL Code 331



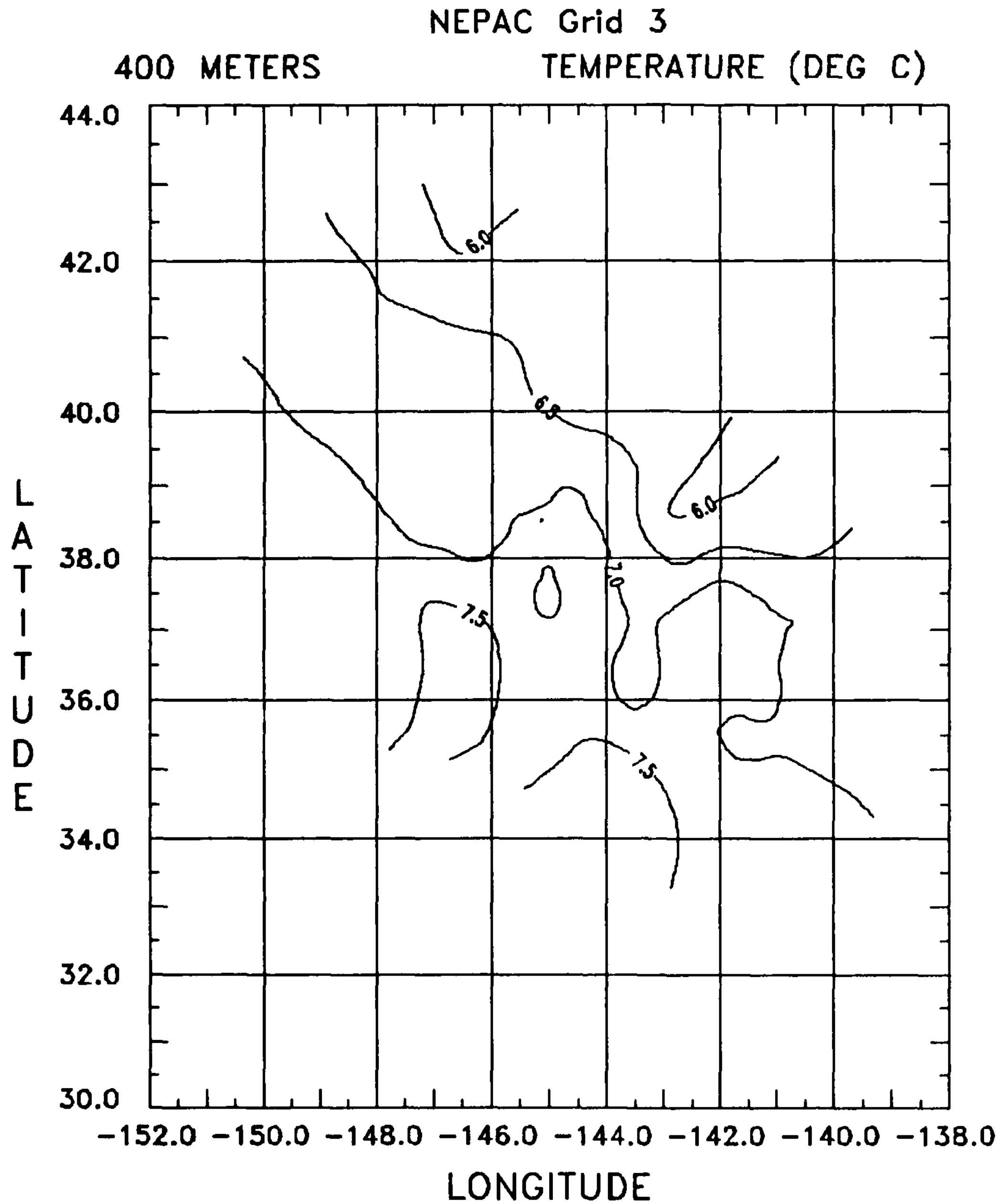
NEPAC Grid 3
250 METERS
TEMPERATURE (DEG C)
LATITUDE
44.0
42.0
40.0
38.0
36.0
34.0
32.0
30.0
−152.0 −150.0 −148.0 −146.0 −144.0 −142.0 −140.0 −138.0
LONGITUDE
8.0
8.5
9.0
9.5
10.0
8:01:12
2/12/90
dx=.3 ,dy=.3
NOARL Code 331

NEPAC Grid 3



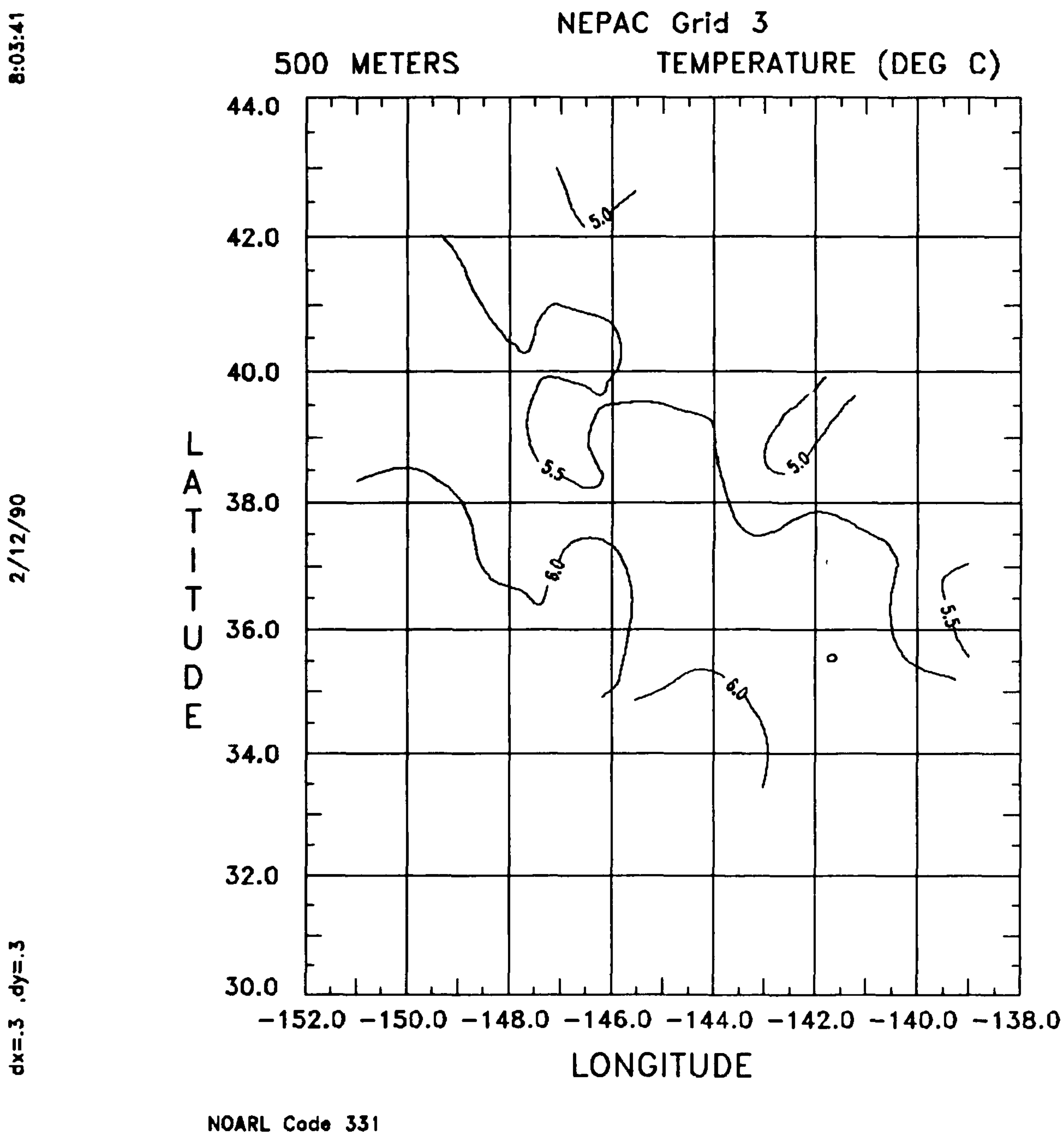
NOARL Code 331

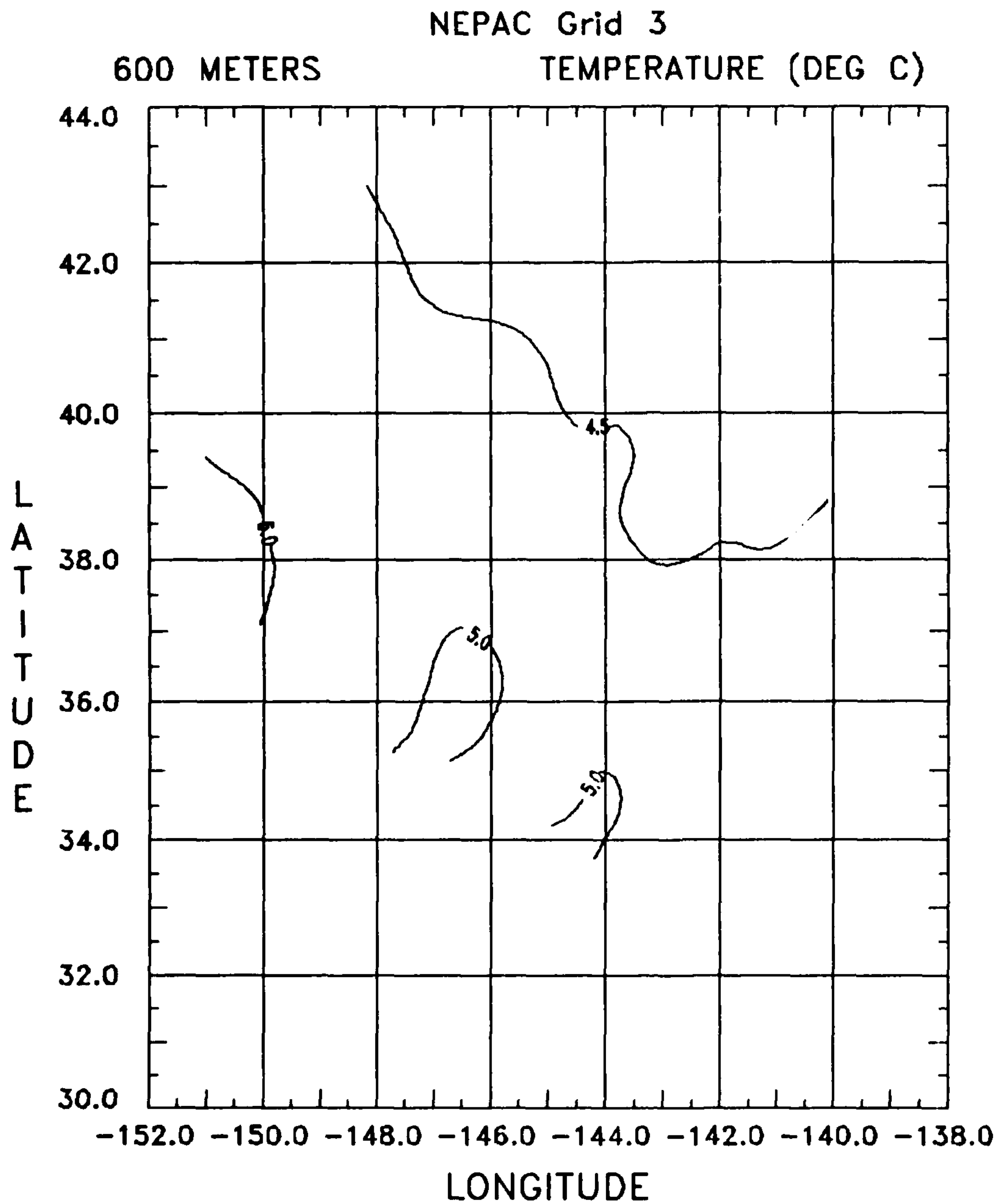
8:02:02 2/12/90 dx=.3 ,dy=.3



NOARL Code 331

8:02:52 2/12/90 dx=.3 ,dy=.3


8:03:41
2/12/90
dx=.3 ,dy=.3
NEPAC Grid 3
500 METERS
TEMPERATURE (DEG C)
LATITUDE
44.0
42.0
40.0
38.0
36.0
34.0
32.0
30.0
−152.0 −150.0 −148.0 −146.0 −144.0 −142.0 −140.0 −138.0
LONGITUDE
5.0
5.5
6.0
NOARL Code 331

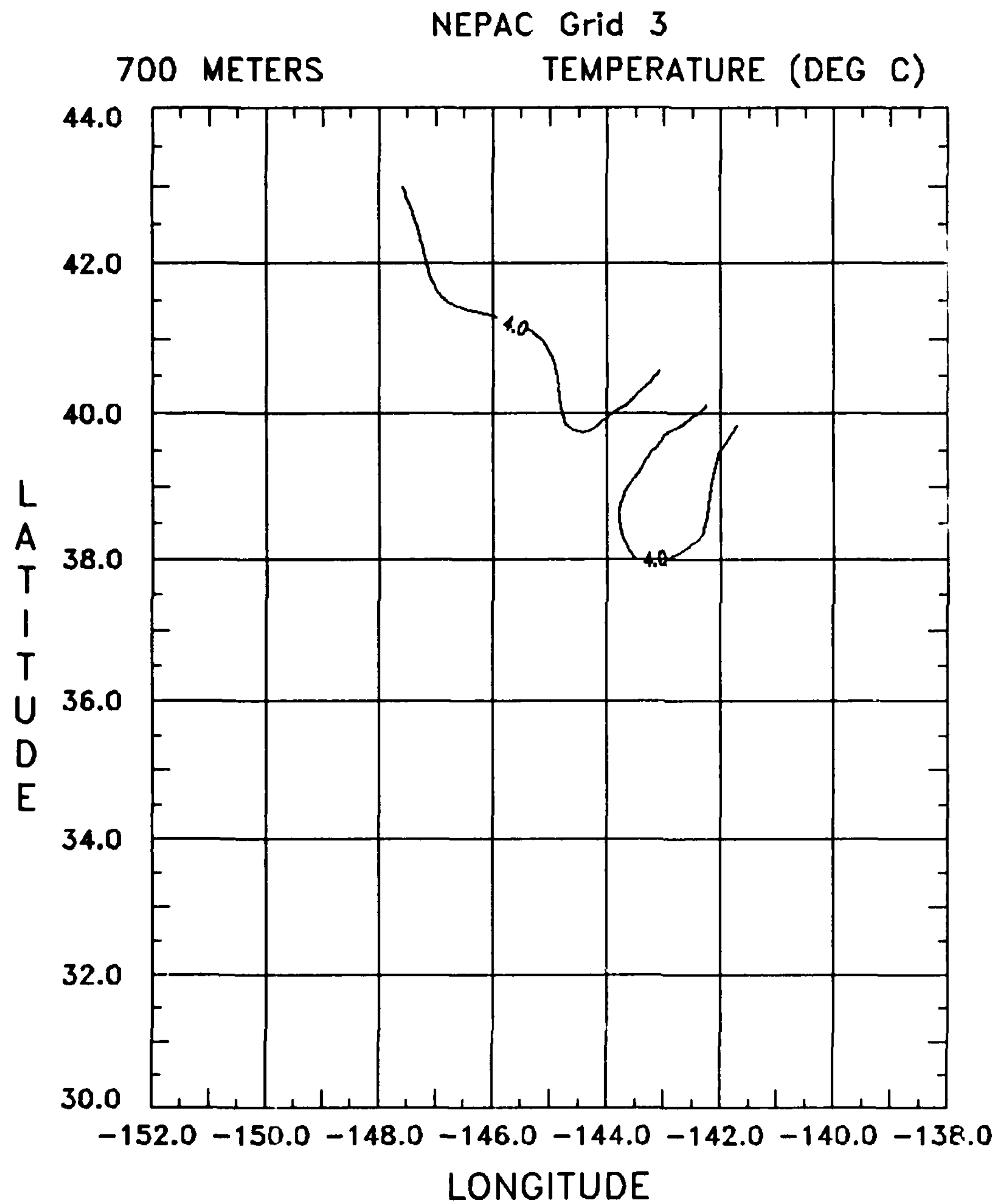


8:04:28

2/12/90

dx=.3 .dy=.3

NOARL Code 331



NOARL Code 331

8:05:12 2/12/90 dx=.3 ,dy=.3

Appendix F.

NEPAC Grid 1 (25 - 28 June 1989)

Temperature Contours along Selected Vertical Transects

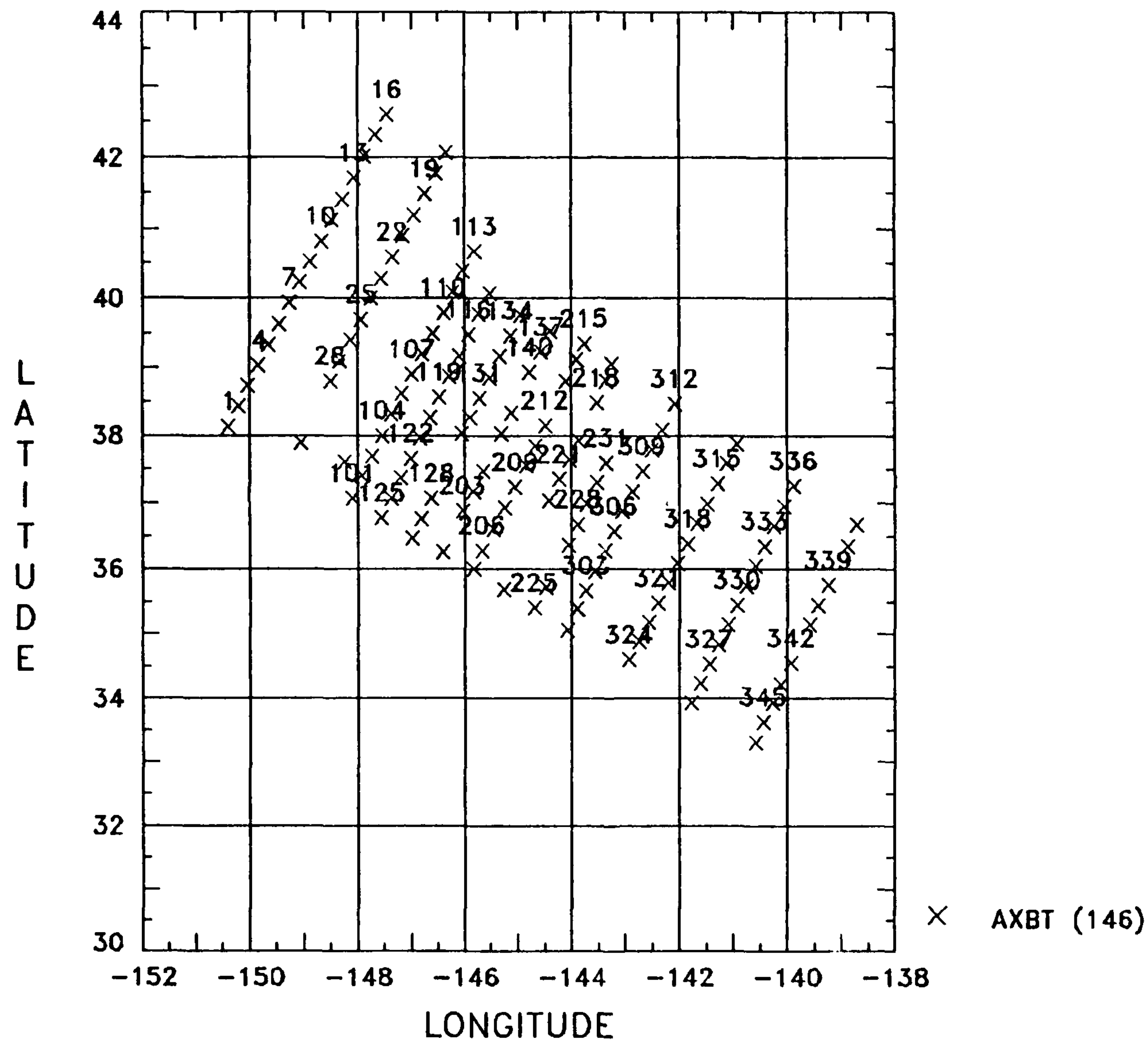
Surface to 300 m

9:05:57

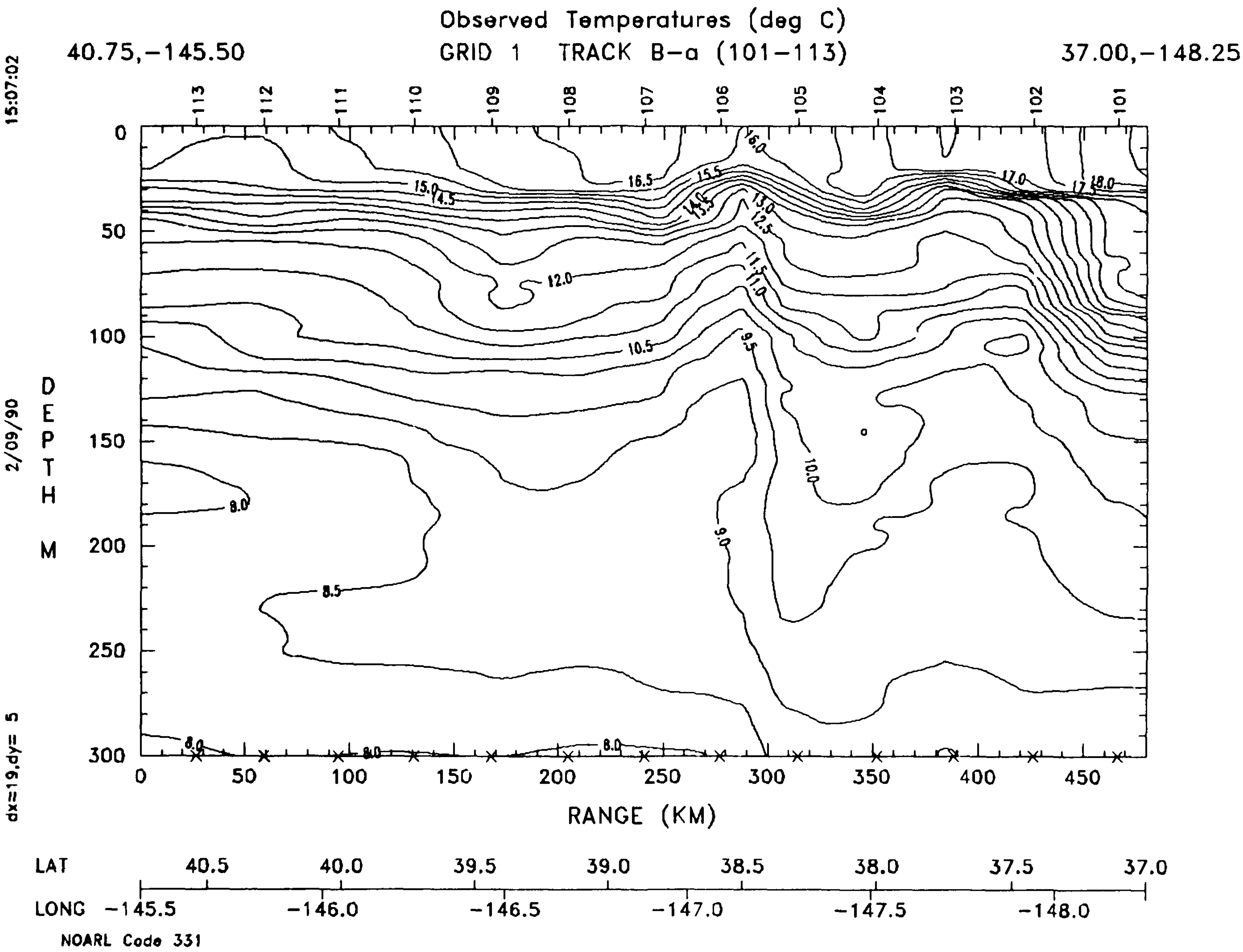
5/09/90

NEPAC Grid 1 (25–28 June 1989)

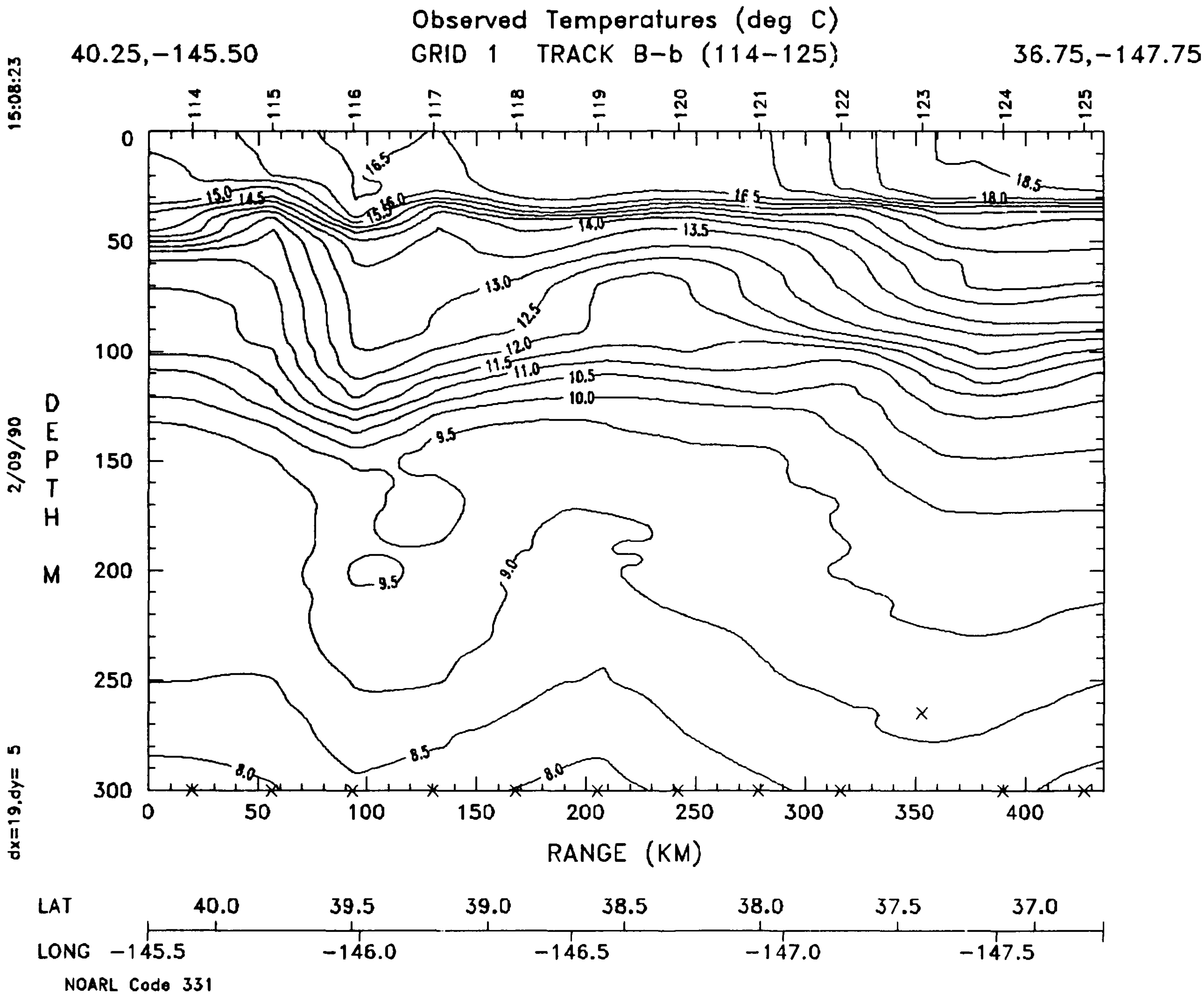
146 Probes



NOARL Code 331

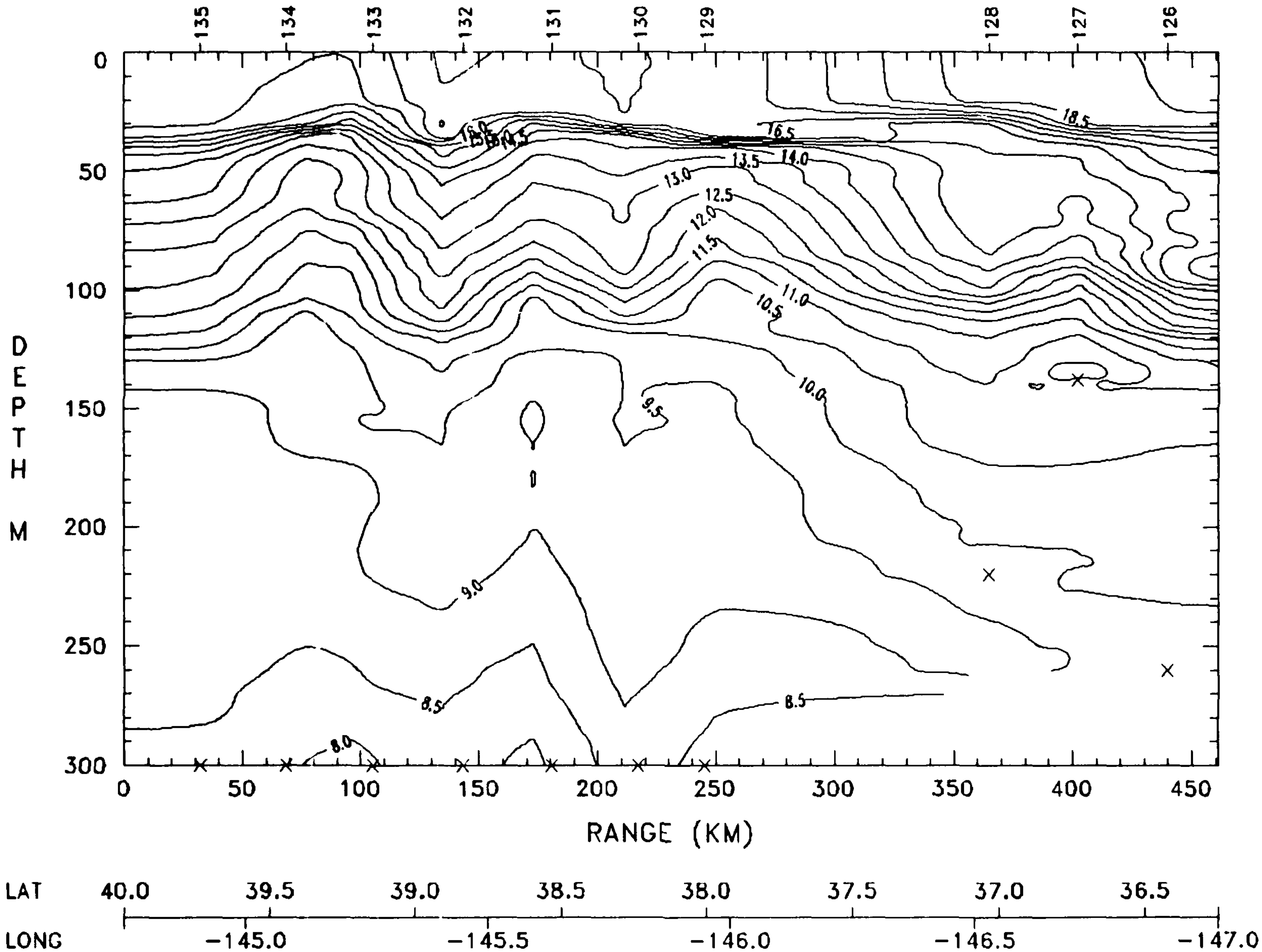


Observed Temperatures (deg C)
40.75,-145.50
GRID 1 TRACK B-a (101-113)
37.00,-148.25
15:07:02
2/09/90
dx=19,dy= 5
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331


Observed Temperatures (deg C)
40.25,-145.50
GRID 1 TRACK B-b (114-125)
36.75,-147.75
15:08:23
2/09/90
dx=19,dy= 5
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331

Observed Temperatures (deg C)

40.00,-144.75 GRID 1 TRACK B-c (126-135) 36.25,-147.00

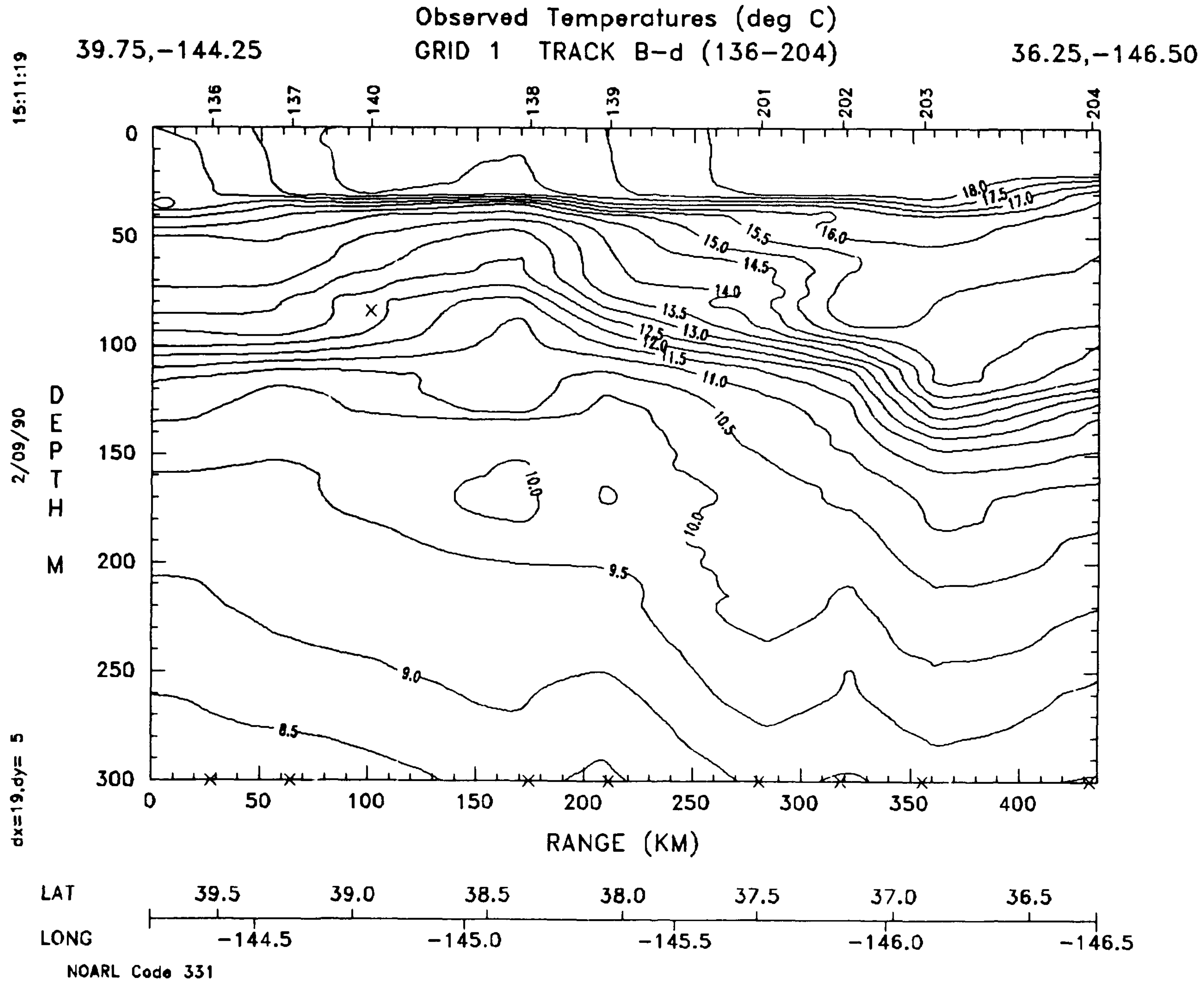


15:10:01

2/09/90

dx=19,dy= 5

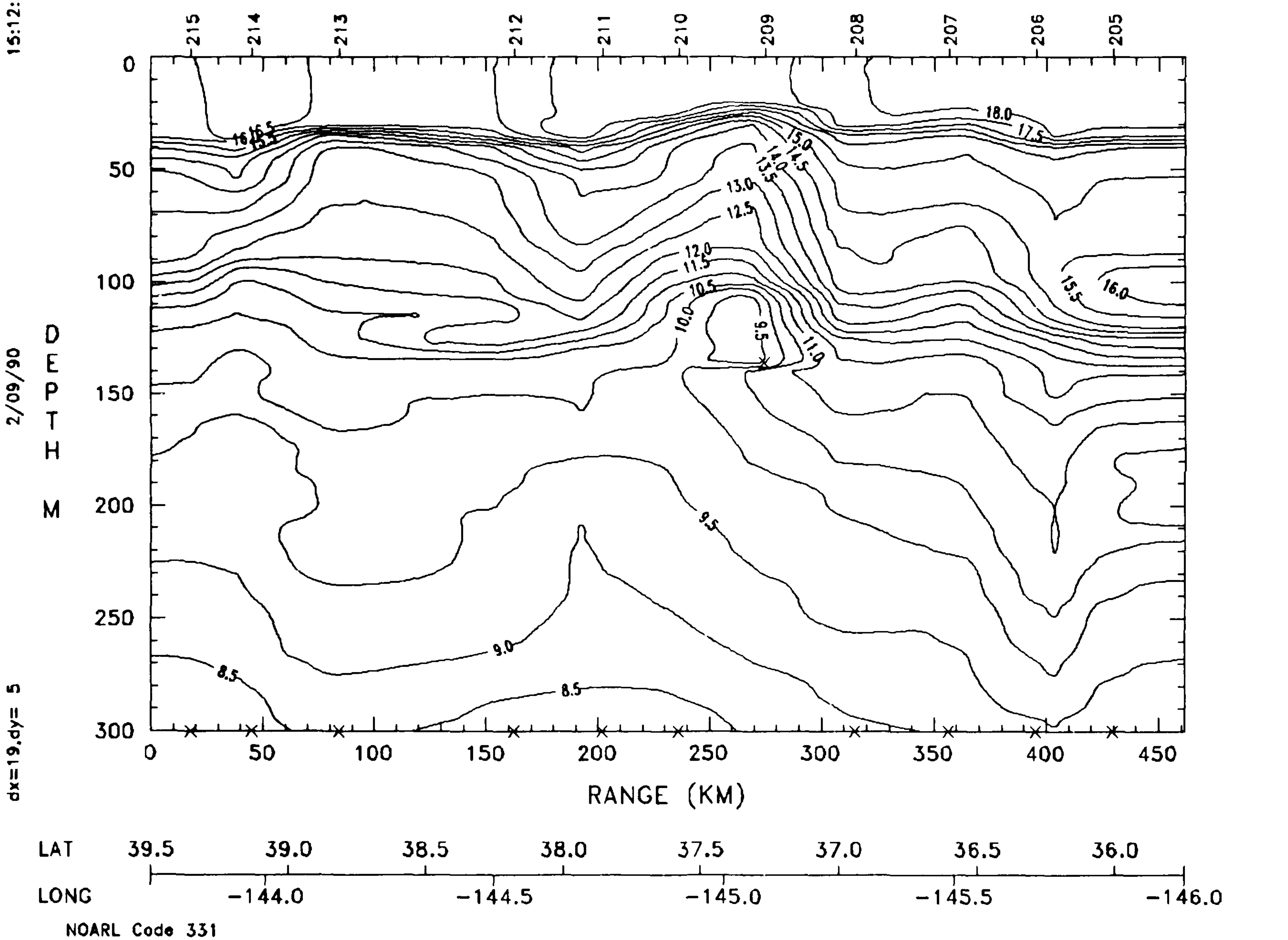
NOARL Code 331



Observed Temperatures (deg C)
39.75,-144.25
GRID 1 TRACK B-d (136-204)
36.25,-146.50
15:11:19
2/09/90
dx=19,dy= 5
136
137
140
138
139
201
202
203
204
DEPTH M
0
50
100
150
200
250
300
18.0
17.5
17.0
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
RANGE (KM)
400
LAT
39.5
39.0
38.5
38.0
37.5
37.0
36.5
LONG
-144.5
-145.0
-145.5
-146.0
-146.5
NOARL Code 331

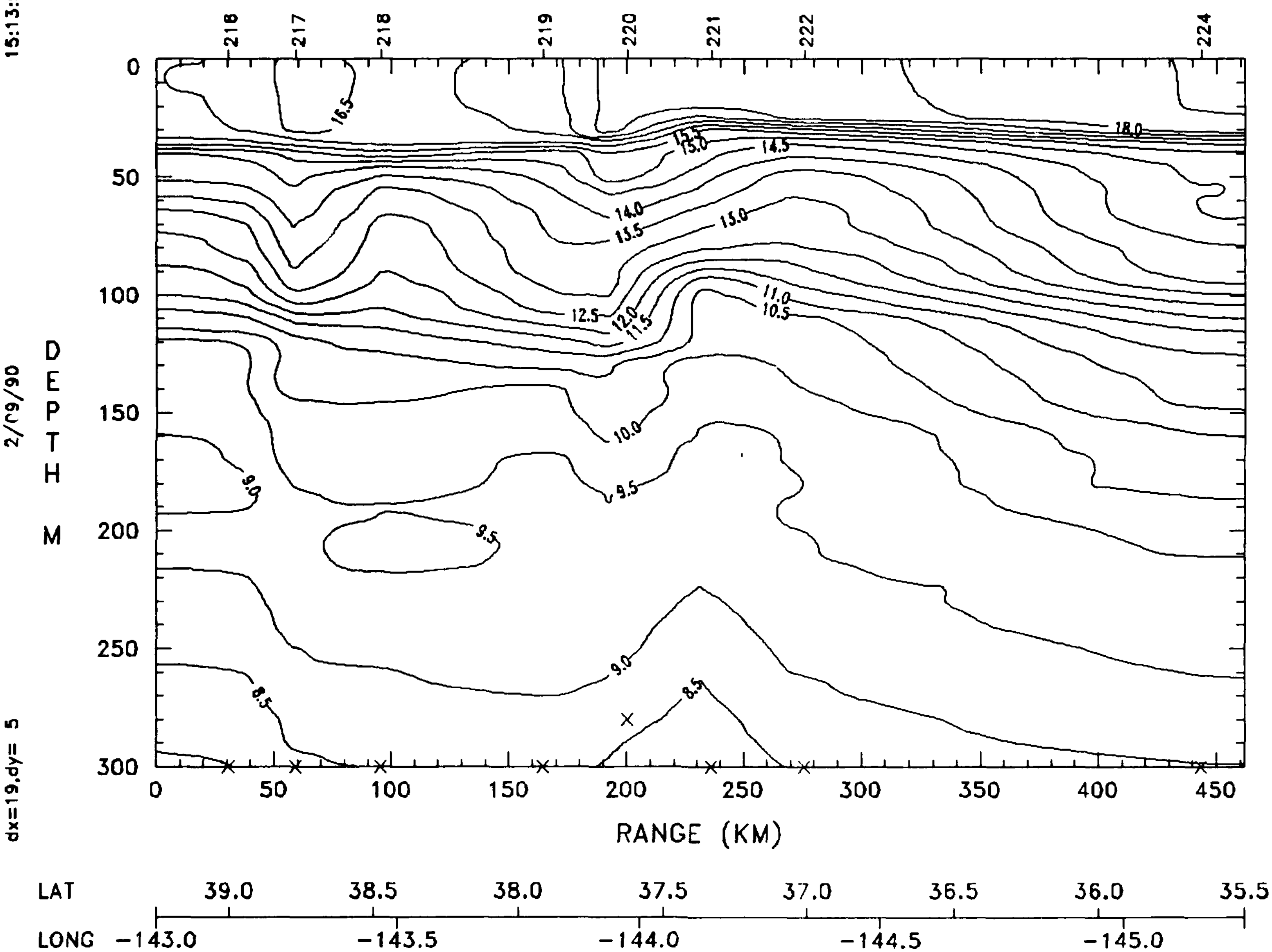
Observed Temperatures (deg C)

39.50,-143.75 GRID 1 TRACK C-a (205-215) 35.75,-146.00



Observed Temperatures (deg C)

39.25,-143.00 GRID 1 TRACK C-b (216-224) 35.50,-145.25

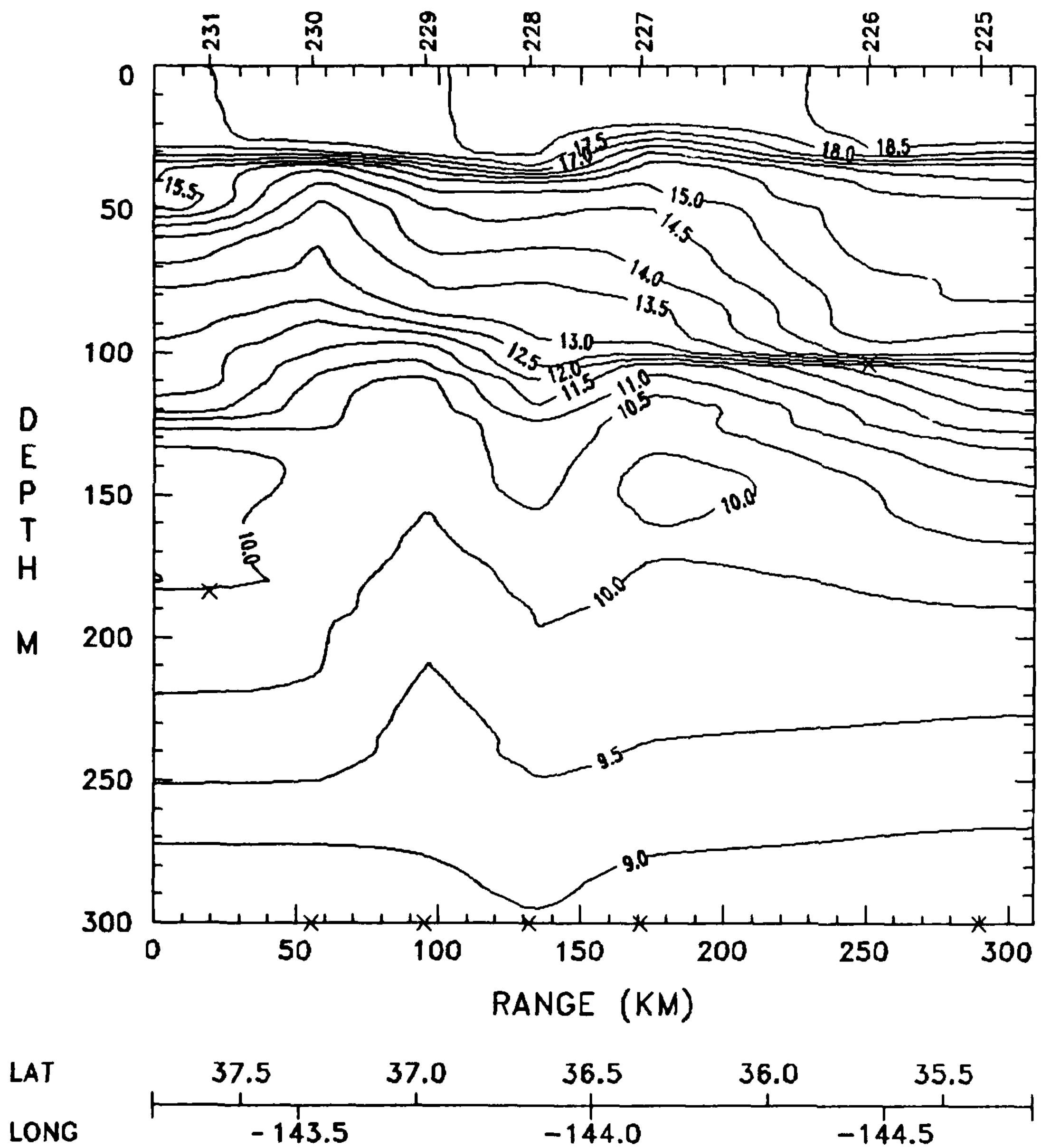


NOARL Code 331

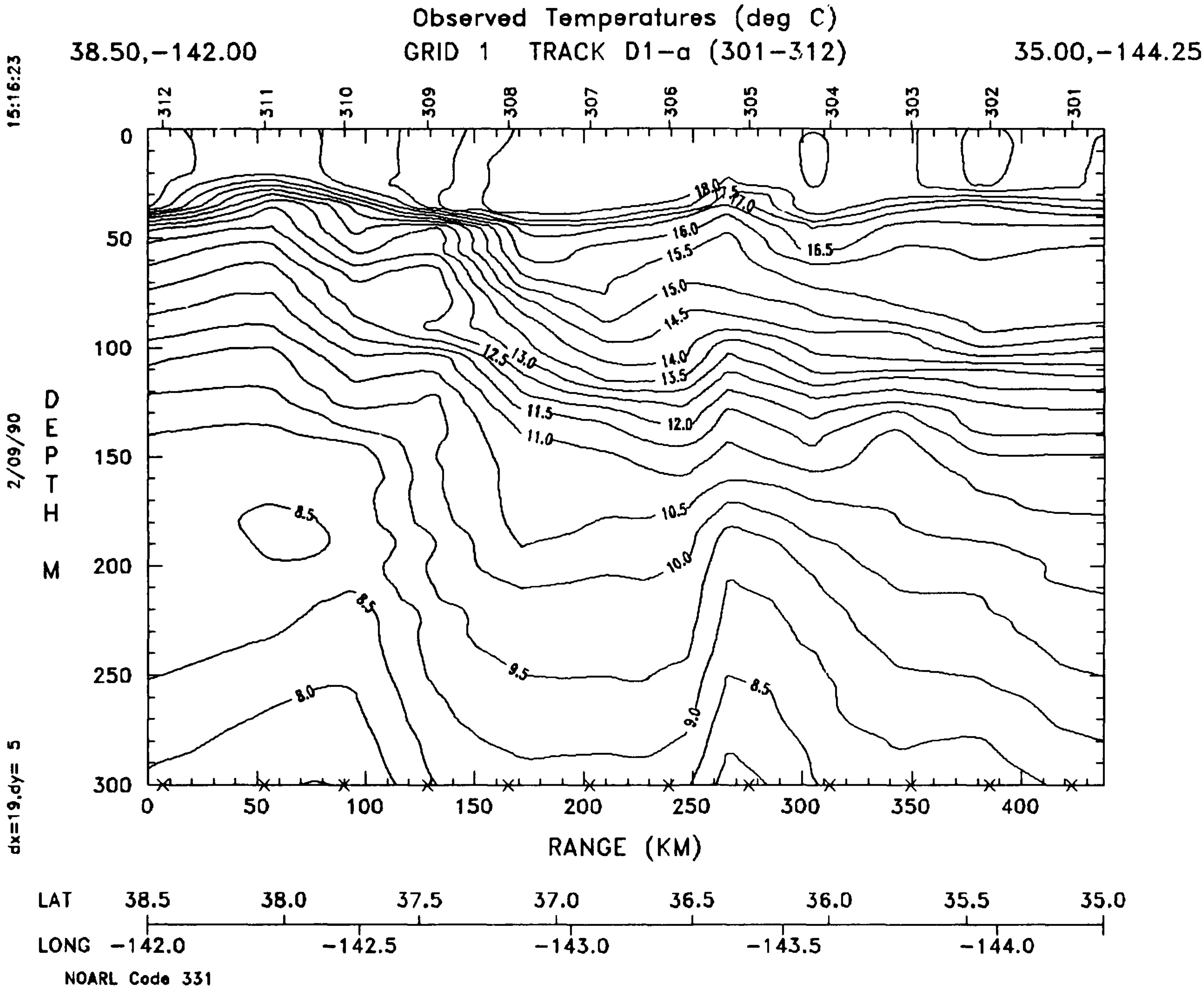
15:15:12 2/09/90 dx=19,dy= 5

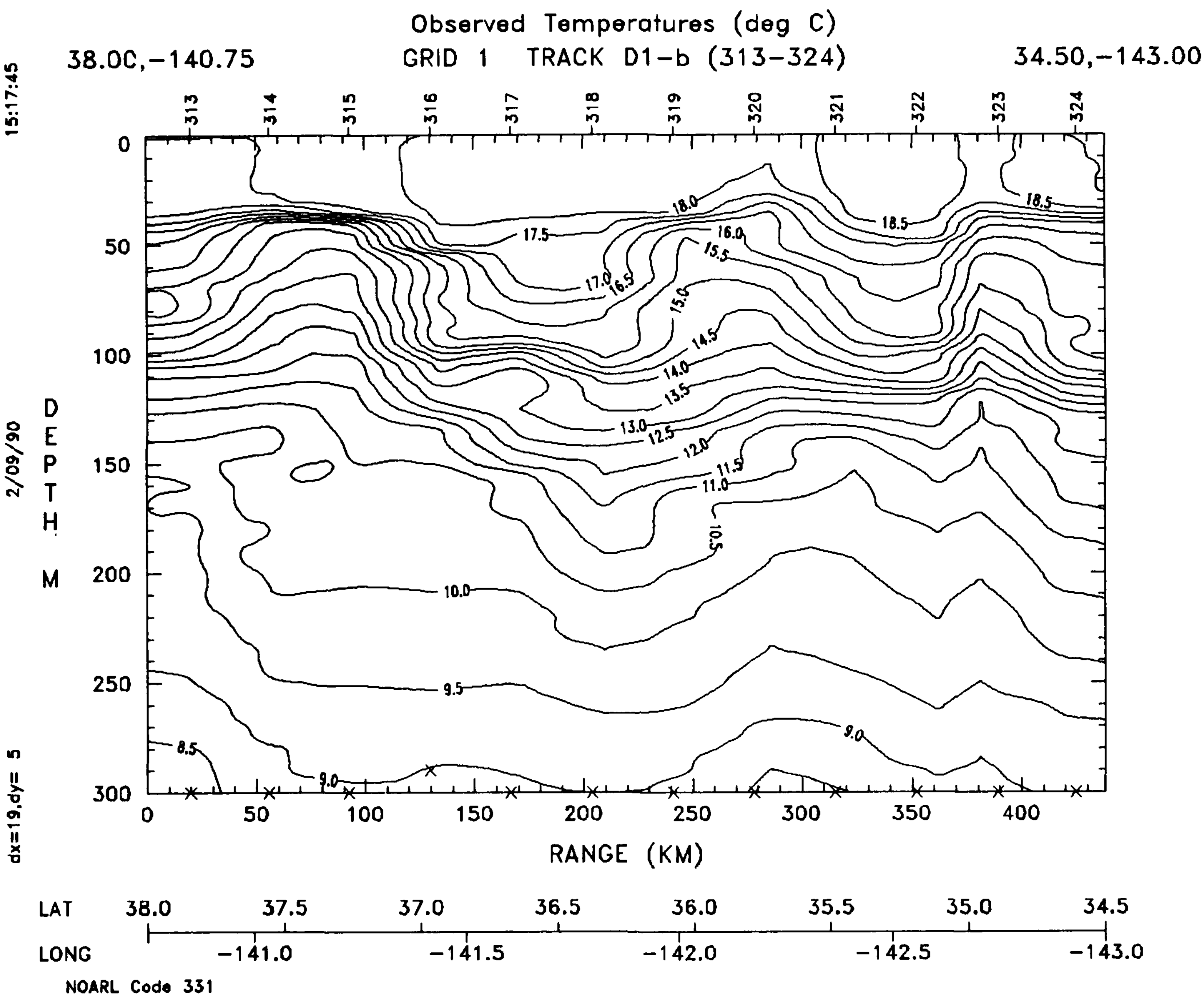
Observed Temperatures (deg C)

37.75,-143.25 GRID 1 TRACK C-c (225-231) 35.25,-144.75

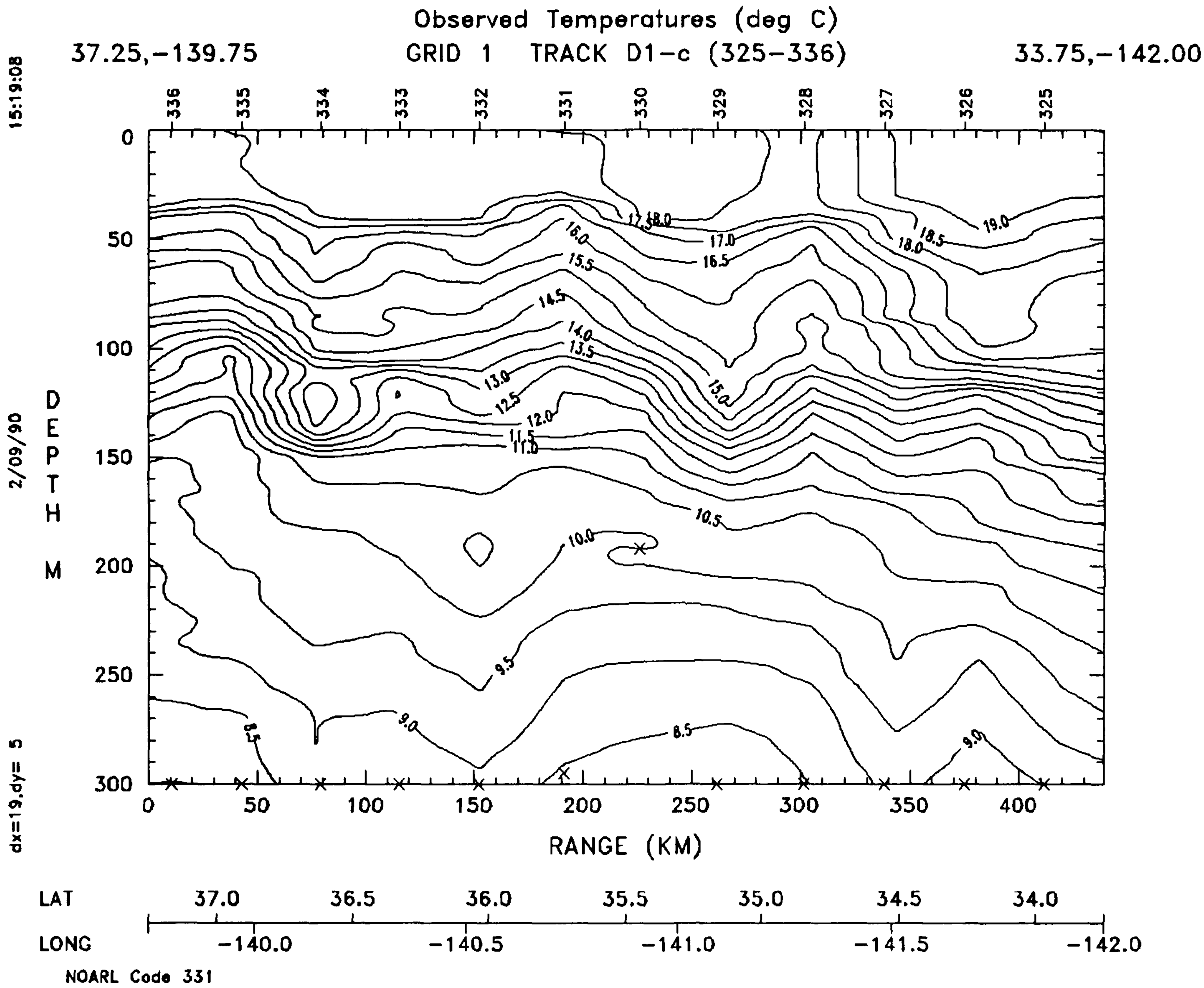


NOARL Code 331

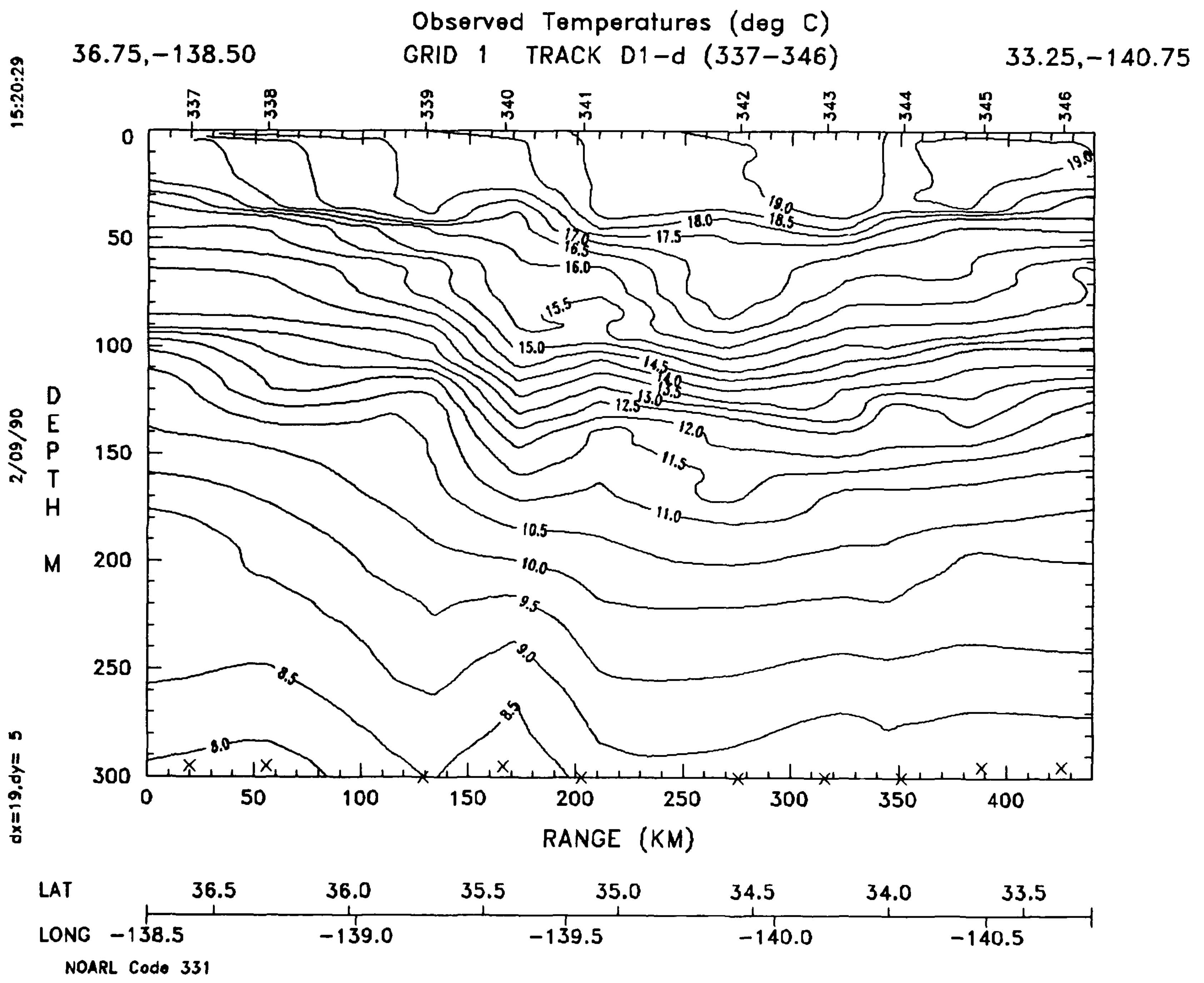

Observed Temperatures (deg C)
38.50,-142.00
GRID 1 TRACK D1-a (301-312)
35.00,-144.25
15:16:23
2/09/90
dx=19,dy= 5
312
311
310
309
308
307
306
305
304
303
302
301
DEPTH M
0
50
100
150
200
250
300
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
RANGE (KM)
400
LAT 38.5 38.0 37.5 37.0 36.5 36.0 35.5 35.0
LONG -142.0 -142.5 -143.0 -143.5 -144.0
NOARL Code 331



Observed Temperatures (deg C)
38.0C,-140.75
GRID 1 TRACK D1-b (313-324)
34.50,-143.00
15:17:45
2/09/90
dx=19,dy= 5
313 314 315 316 317 318 319 320 321 322 323 324
DEPTH M
0 50 100 150 200 250 300
RANGE (KM)
0 50 100 150 200 250 300 350 400
18.5 18.0 17.5 17.0 16.5 16.0 15.5 15.0 14.5 14.0 13.5 13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5
LAT 38.0 37.5 37.0 36.5 36.0 35.5 35.0 34.5
LONG -141.0 -141.5 -142.0 -142.5 -143.0
NOARL Code 331



15:19:08
Observed Temperatures (deg C)
37.25,-139.75
GRID 1 TRACK D1-c (325-336)
33.75,-142.00
336
335
334
333
332
331
330
329
328
327
326
325
2/09/90
DEPTH M
0
50
100
150
200
250
300
19.0
18.5
18.0
17.5
18.0
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
dx=19,dy= 5
0
50
100
150
200
250
300
350
400
RANGE (KM)
LAT
37.0
36.5
36.0
35.5
35.0
34.5
34.0
LONG
-140.0
-140.5
-141.0
-141.5
-142.0
NOARL Code 331



Observed Temperatures (deg C)
36.75,-138.50
GRID 1 TRACK D1-d (337-346)
33.25,-140.75
15:20:29
2/09/90
dx=19,dy= 5
337
338
339
340
341
342
343
344
345
346
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
0
50
100
150
200
250
300
350
400
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
LAT
36.5
36.0
35.5
35.0
34.5
34.0
33.5
LONG
-138.5
-139.0
-139.5
-140.0
-140.5
NOARL Code 331

Appendix G

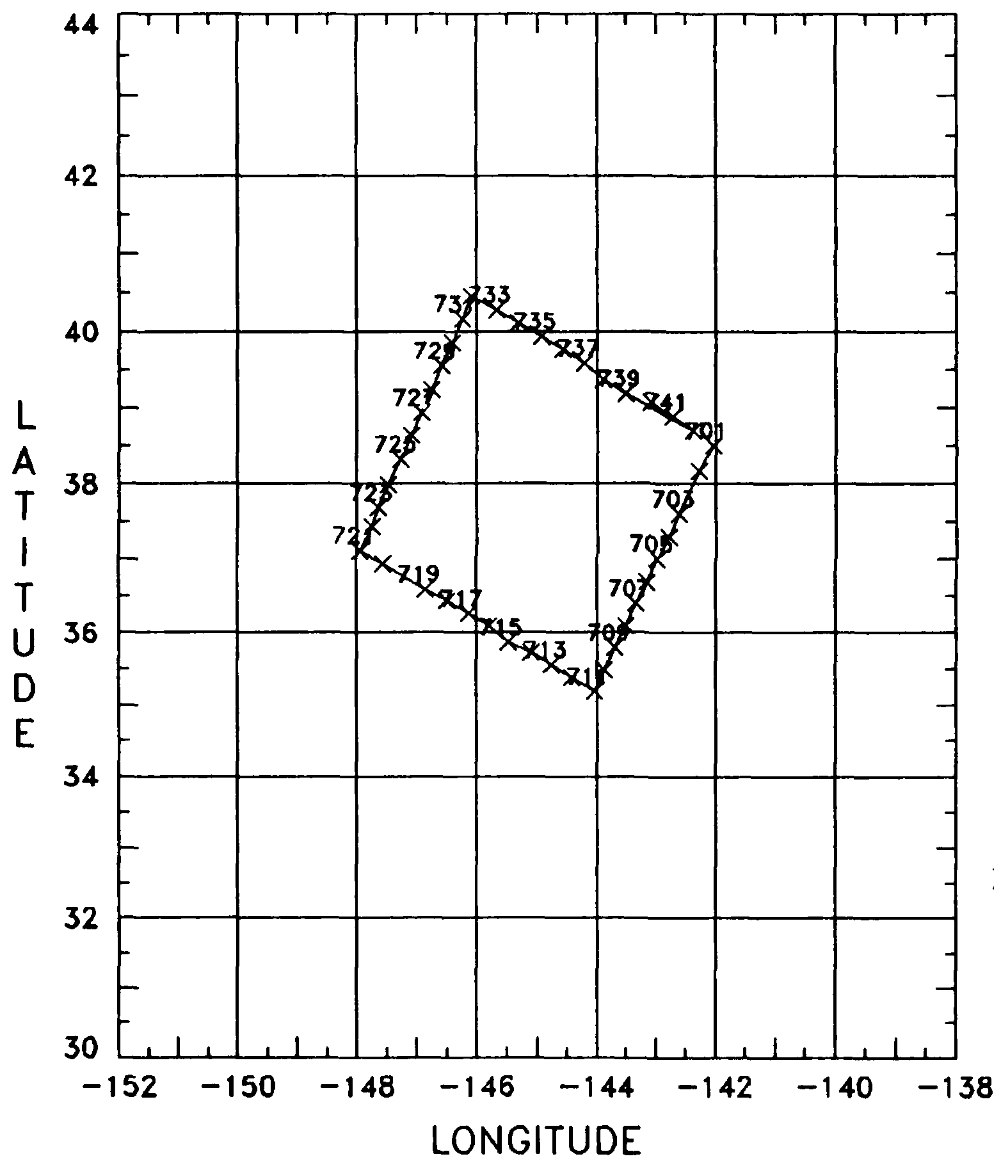
NEPAC Boundary Flight 1 (30 June 1989)

Vertical Temperature Contours along All 4 Sides

Surface to 300 m

NEPAC Boundary 1

42 Probes



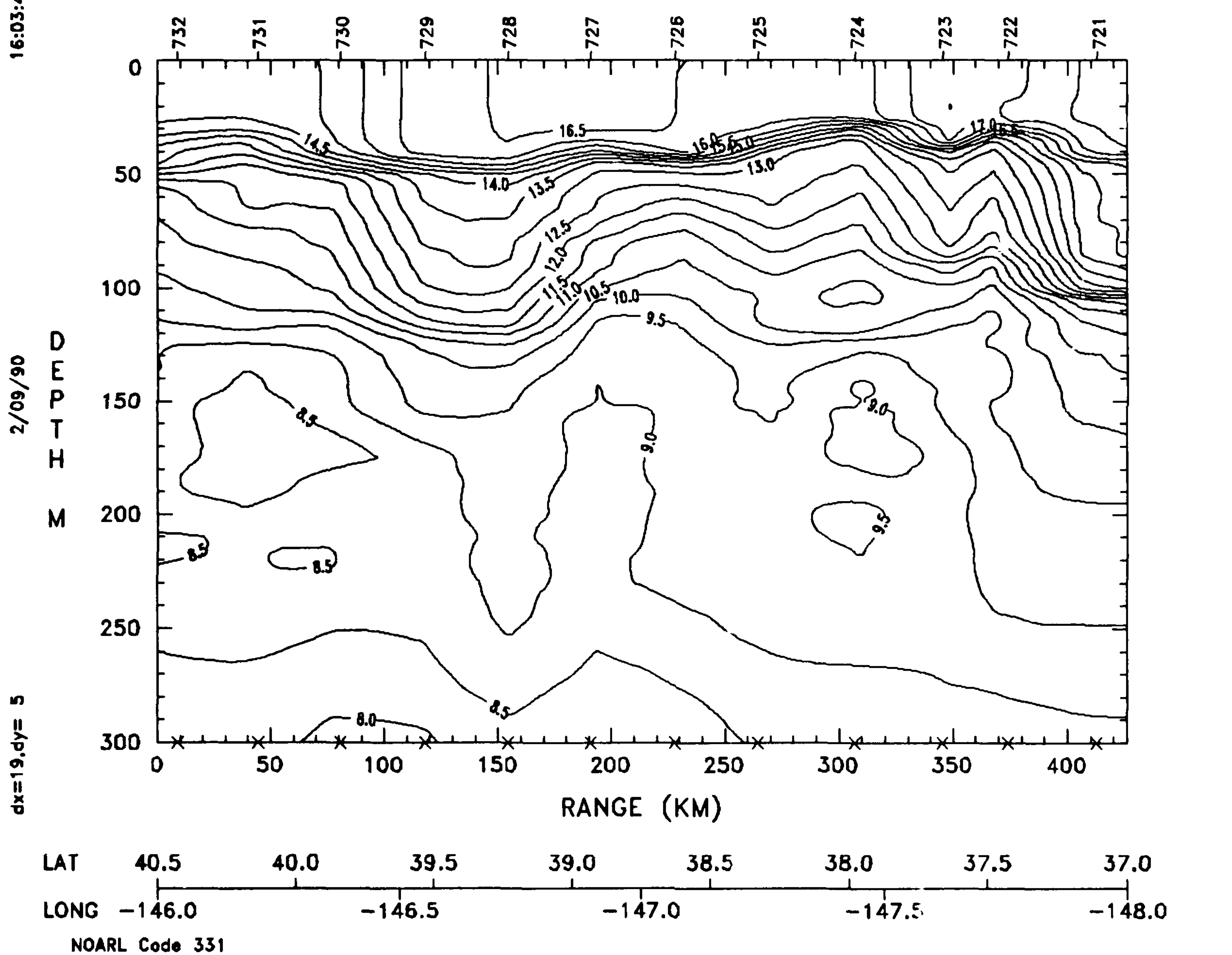
X = AXBT (42)

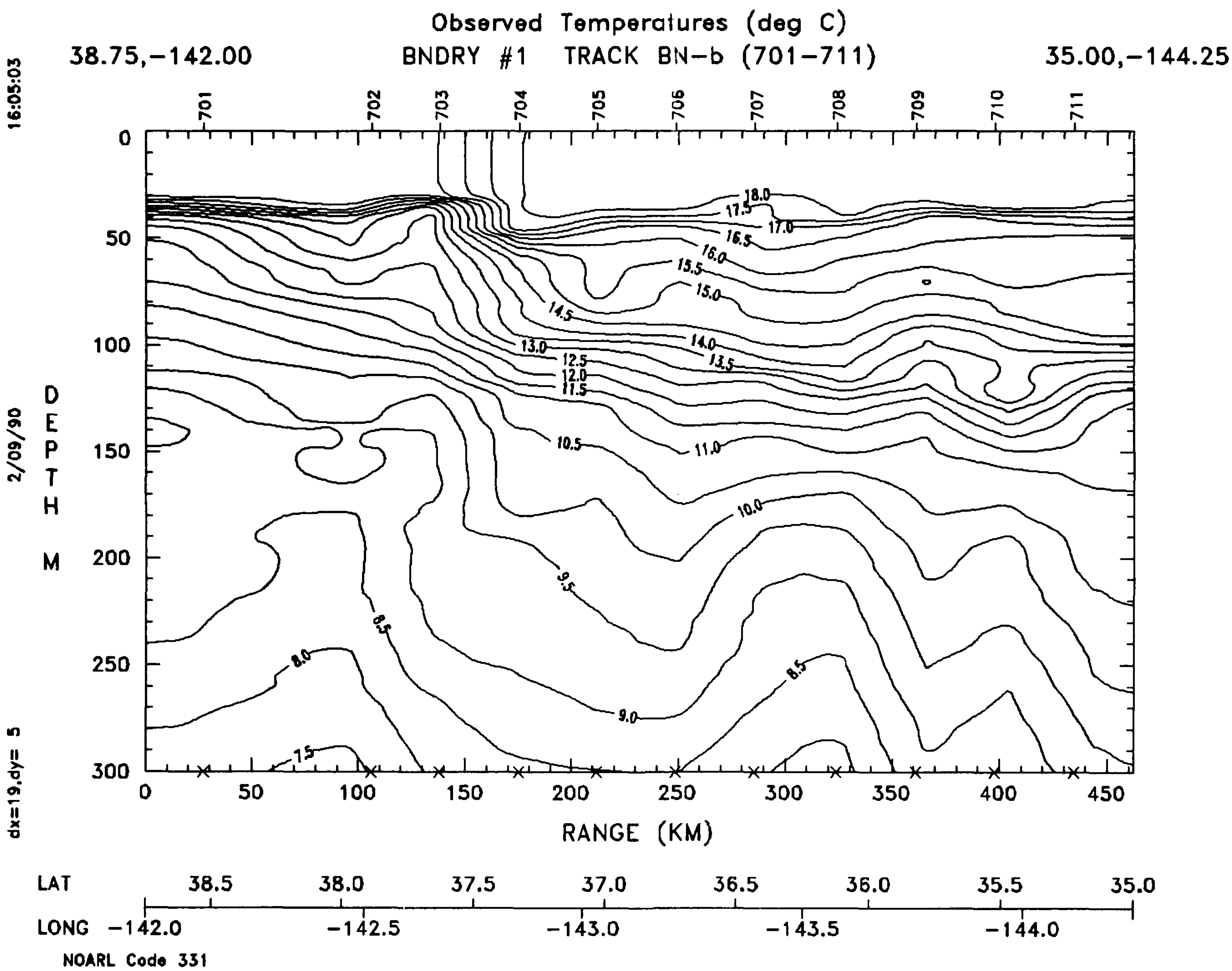
NOARL Code 331

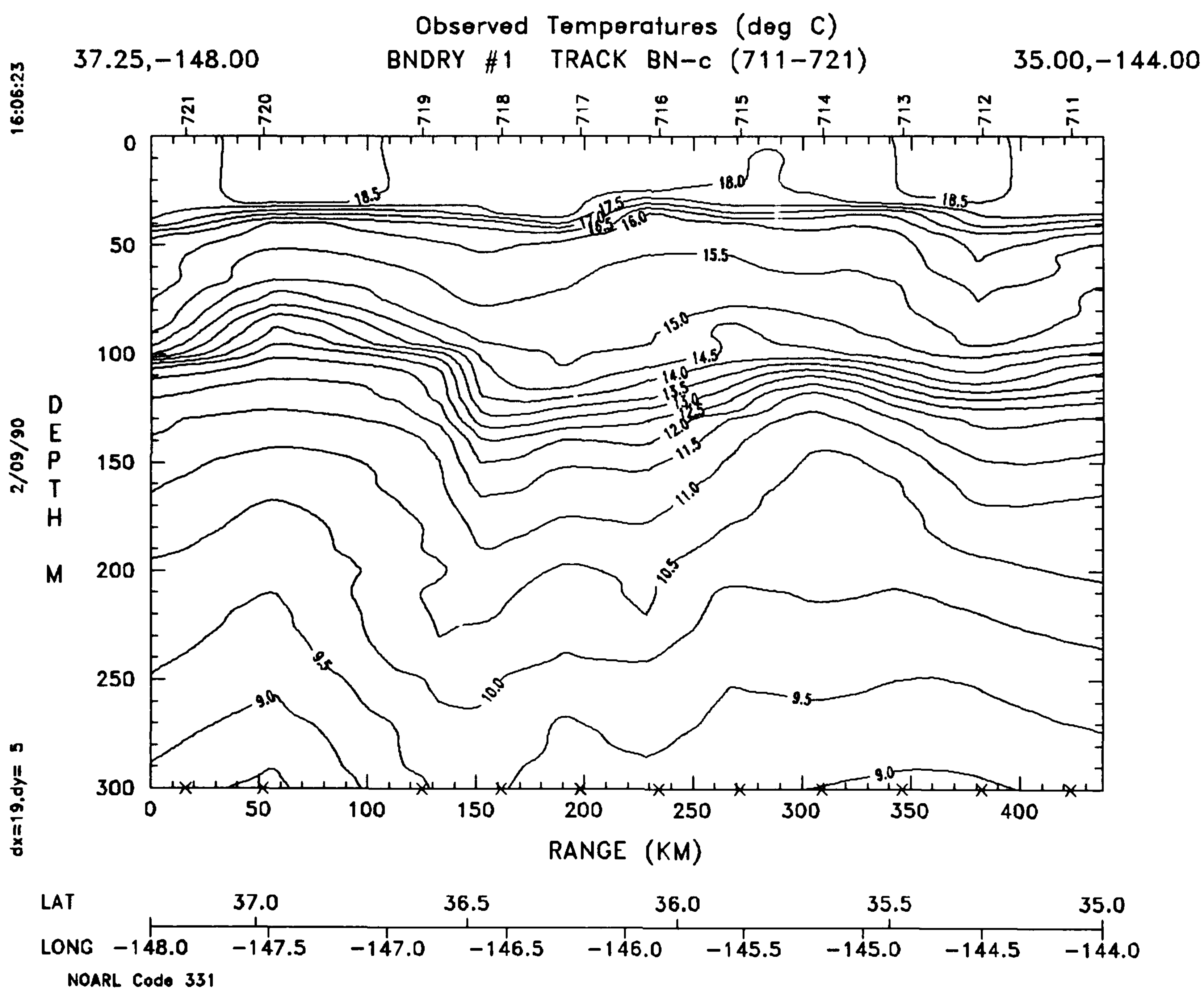
11/28/89 14:32:11

Observed Temperatures (deg C)

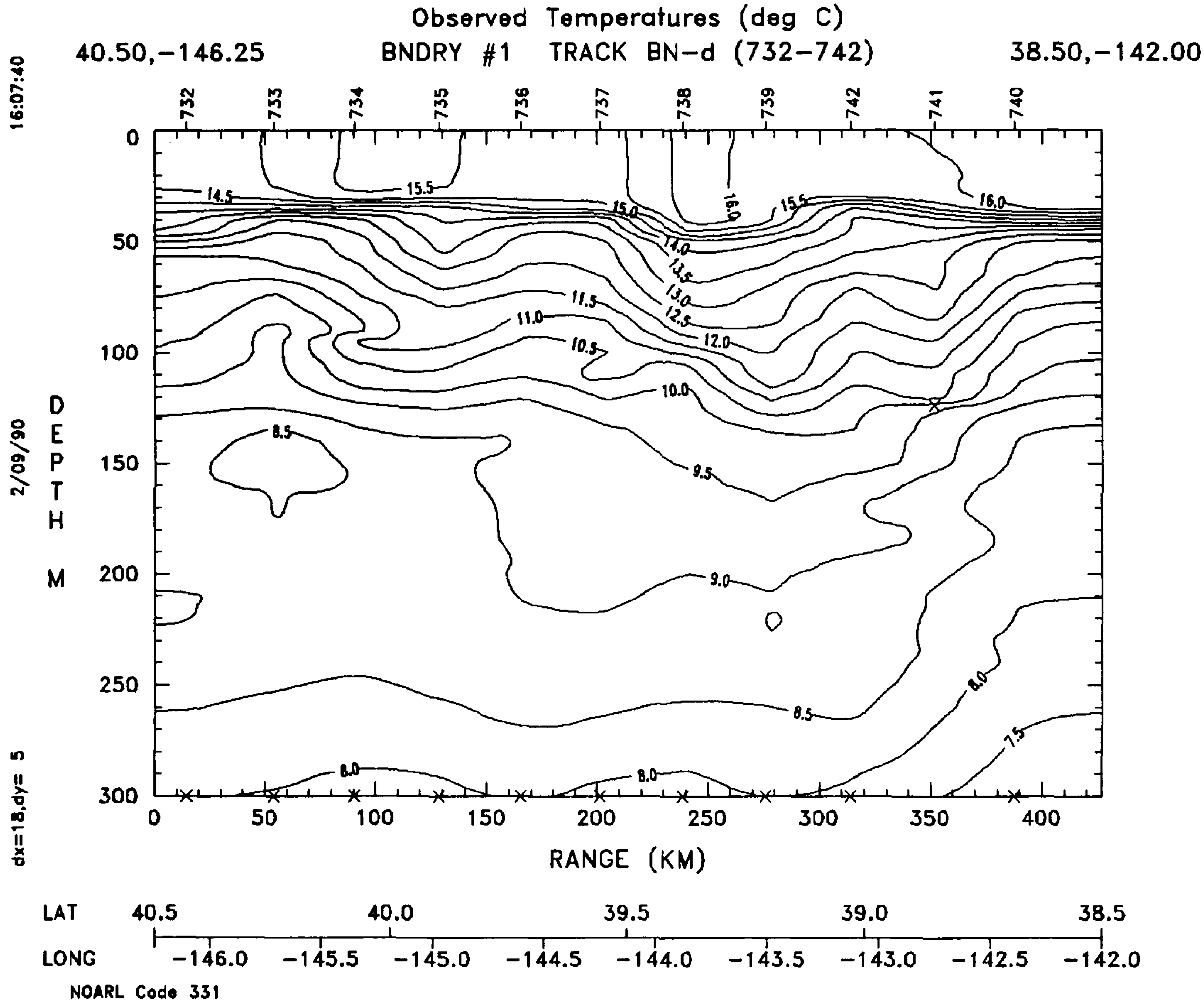
40.50,-146.00 BNDRY #1 TRACK BN-a (721-732) 37.00,-148.00




Observed Temperatures (deg C)
38.75,-142.00
BNDRY #1 TRACK BN-b (701-711)
35.00,-144.25
16:05:03
2/09/90
dx=19,dy= 5
701
702
703
704
705
706
707
708
709
710
711
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
450
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
LAT
38.5
38.0
37.5
37.0
36.5
36.0
35.5
35.0
LONG
-142.0
-142.5
-143.0
-143.5
-144.0
NOARL Code 331



Observed Temperatures (deg C)
37.25,-148.00
BNDRY #1 TRACK BN-c (711-721)
35.00,-144.00
16:06:23
2/09/90
dx=19,dy= 5
721
720
719
718
717
716
715
714
713
712
711
DEPTH M
0
50
100
150
200
250
300
18.5
18.0
17.5
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
RANGE (KM)
0
50
100
150
200
250
300
350
400
LAT
37.0
36.5
36.0
35.5
35.0
LONG
-148.0
-147.5
-147.0
-146.5
-146.0
-145.5
-145.0
-144.5
-144.0
NOARL Code 331



Observed Temperatures (deg C)
40.50,-146.25
BNDRY #1 TRACK BN-d (732-742)
38.50,-142.00
16:07:40
2/09/90
dx=18,dy= 5
732
733
734
735
736
737
738
739
742
741
740
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
400
350
14.5
15.5
15.0
16.0
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
LAT
40.5
40.0
39.5
39.0
38.5
LONG
-146.0
-145.5
-145.0
-144.5
-144.0
-143.5
-143.0
-142.5
-142.0
NOARL Code 331

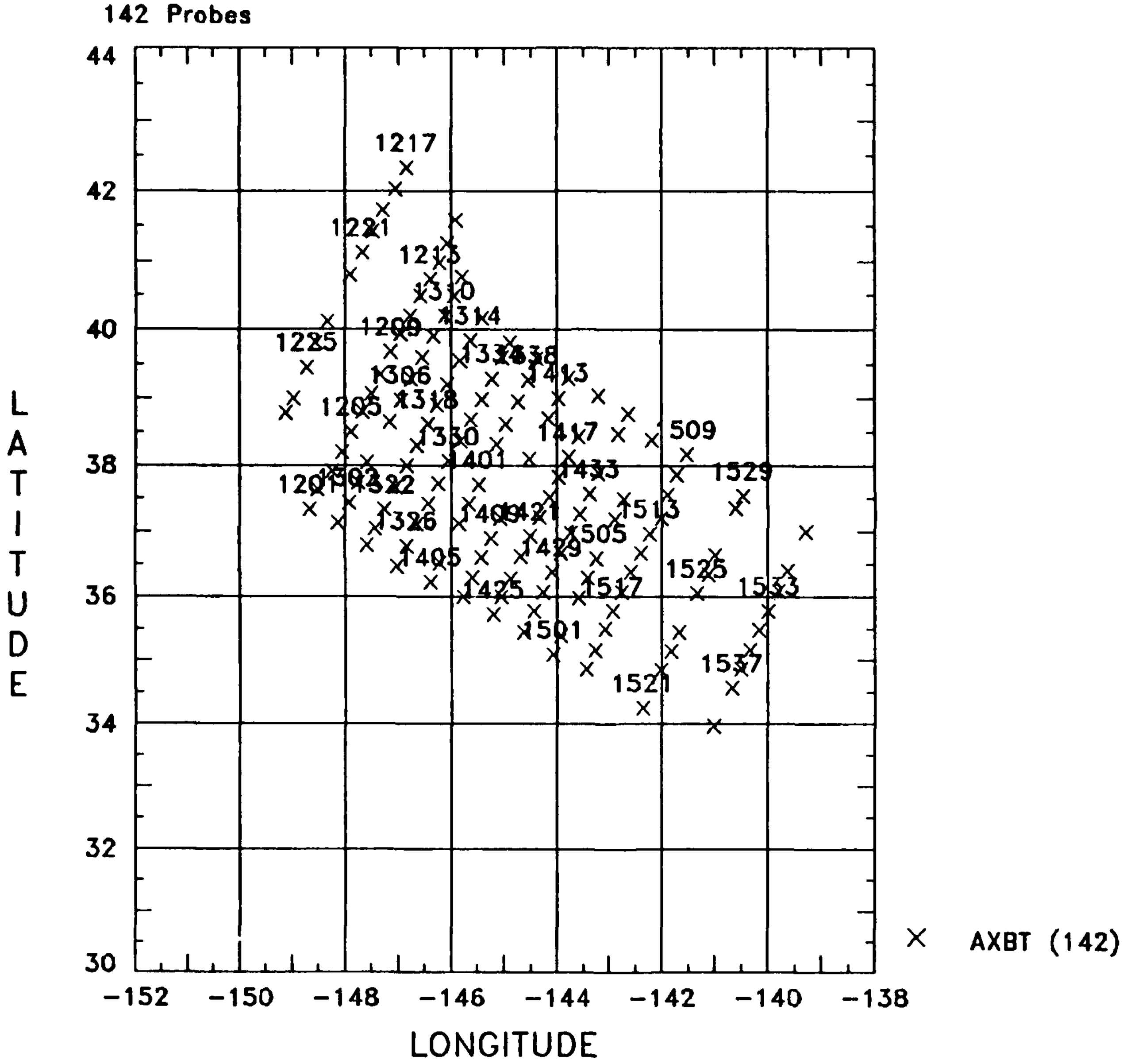
Appendix H.

NEPAC Grid 2 (6 - 7 July 1989)

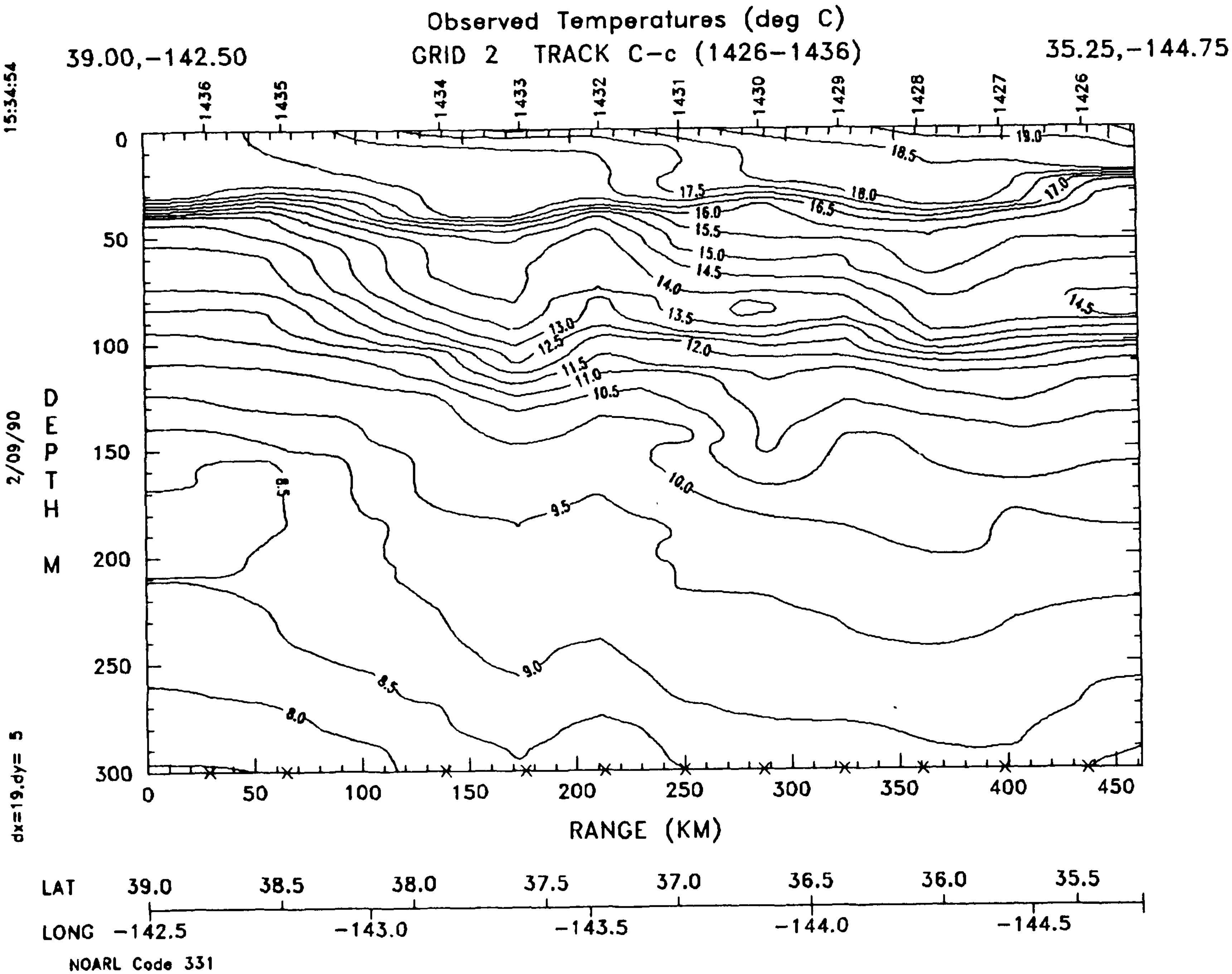
Temperature Contours along Selected Vertical Transects

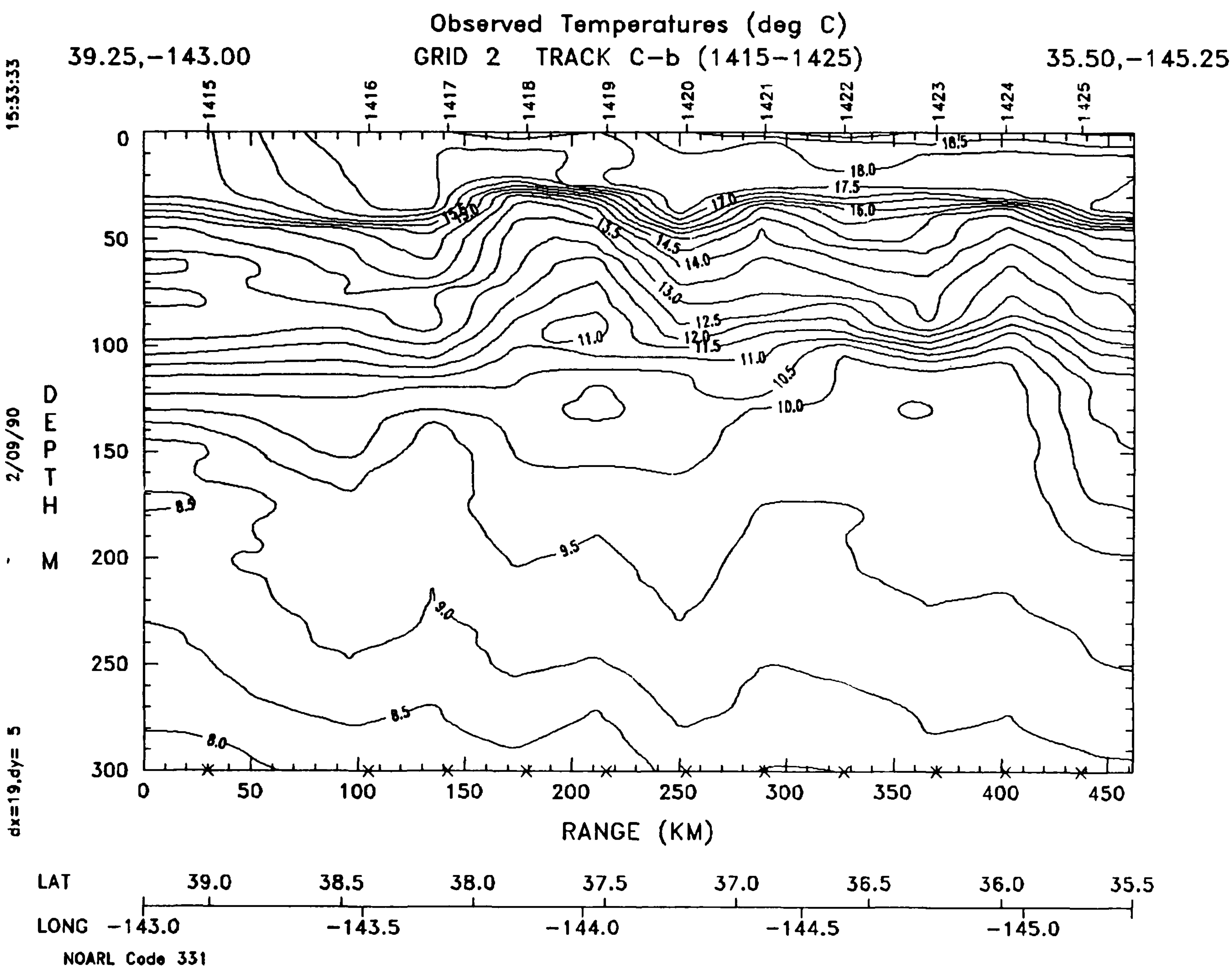
Surface to 300 m

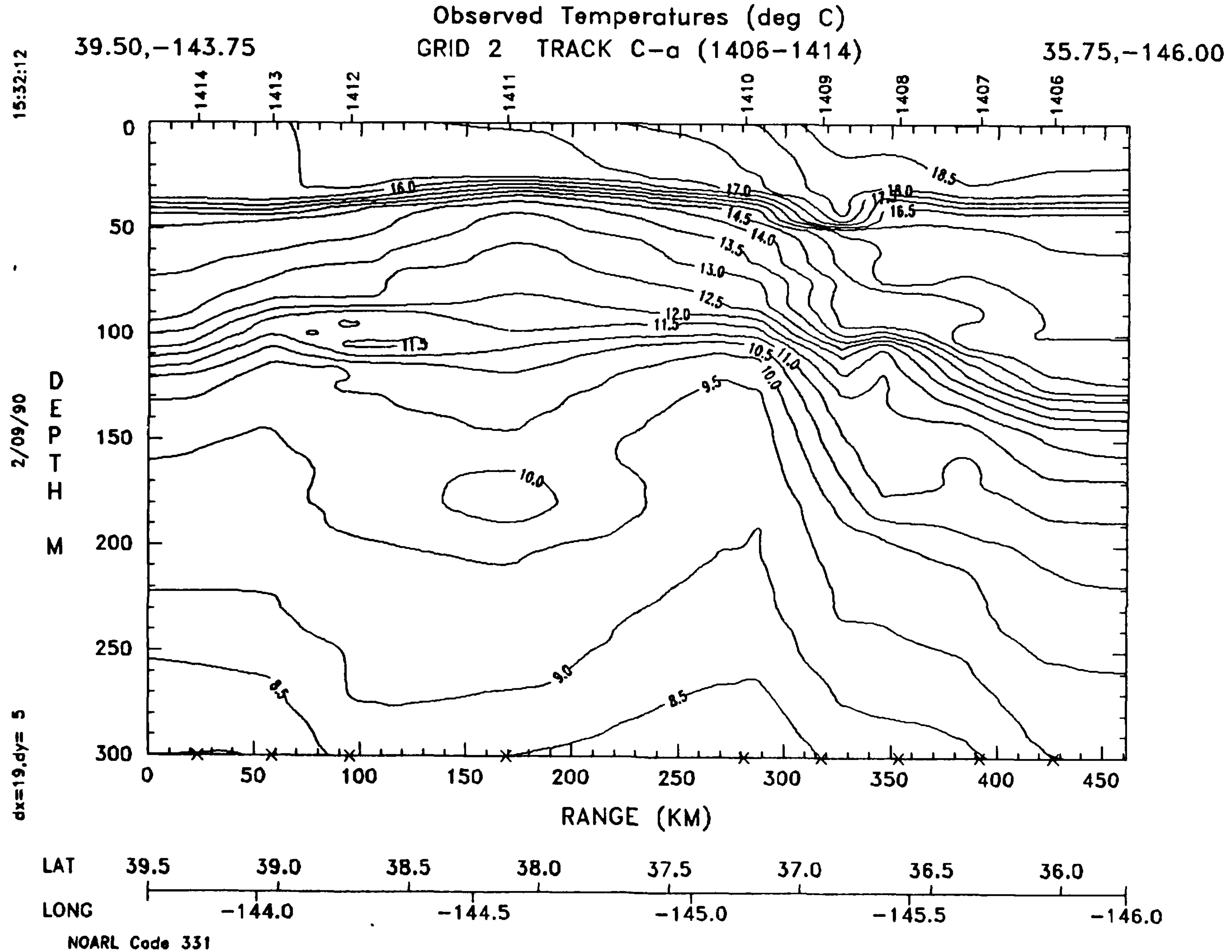
NEPAC Grid 2 (6–7 July 1989)

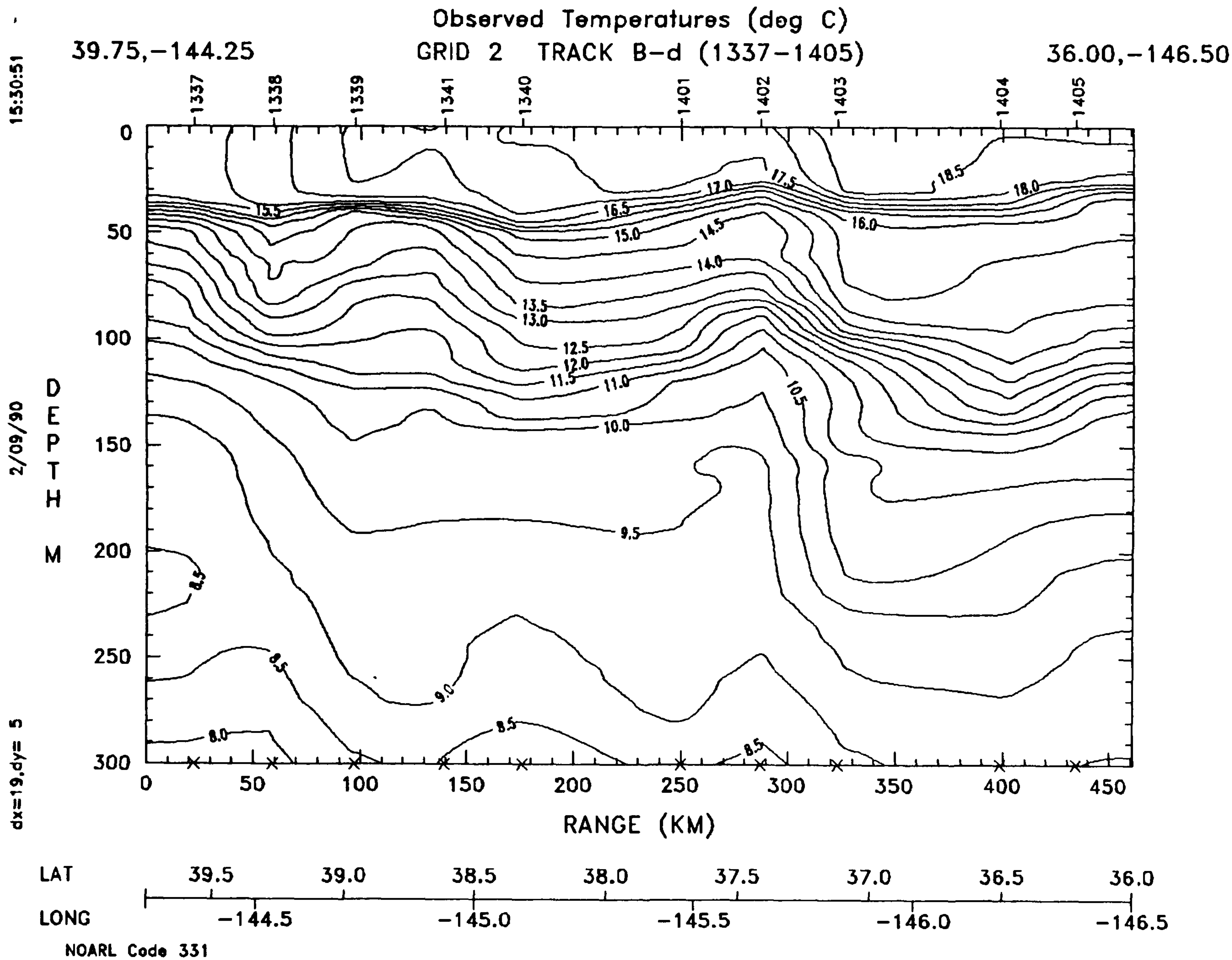


NOARL Code 331

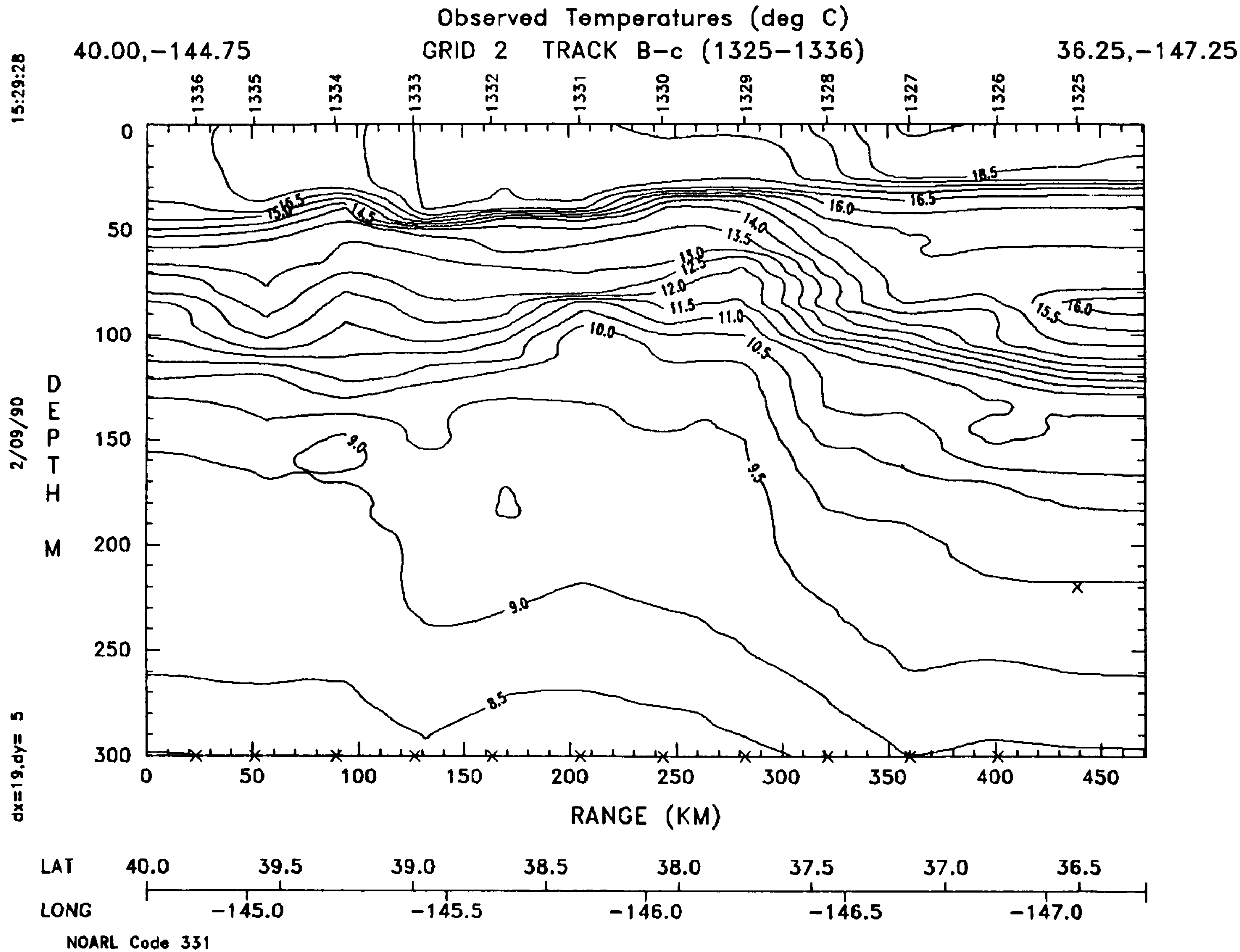

Observed Temperatures (deg C)
39.00,-142.50
GRID 2 TRACK C-c (1426-1436)
35.25,-144.75
15:34:54
2/09/90
dx=19,dy= 5
1436
1435
1434
1433
1432
1431
1430
1429
1428
1427
1426
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
0
50
100
150
200
250
300
350
400
450
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
LAT
39.0
38.5
38.0
37.5
37.0
36.5
36.0
35.5
LONG
-142.5
-143.0
-143.5
-144.0
-144.5
NOARL Code 331


Observed Temperatures (deg C)
39.25,-143.00
GRID 2 TRACK C-b (1415-1425)
35.50,-145.25
15:33:33
2/09/90
dx=19,dy= 5
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
18.5
18.0
17.5
17.0
16.0
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
0
50
100
150
200
250
300
350
400
450
LAT
39.0
38.5
38.0
37.5
37.0
36.5
36.0
35.5
LONG
-143.0
-143.5
-144.0
-144.5
-145.0
NOARL Code 331

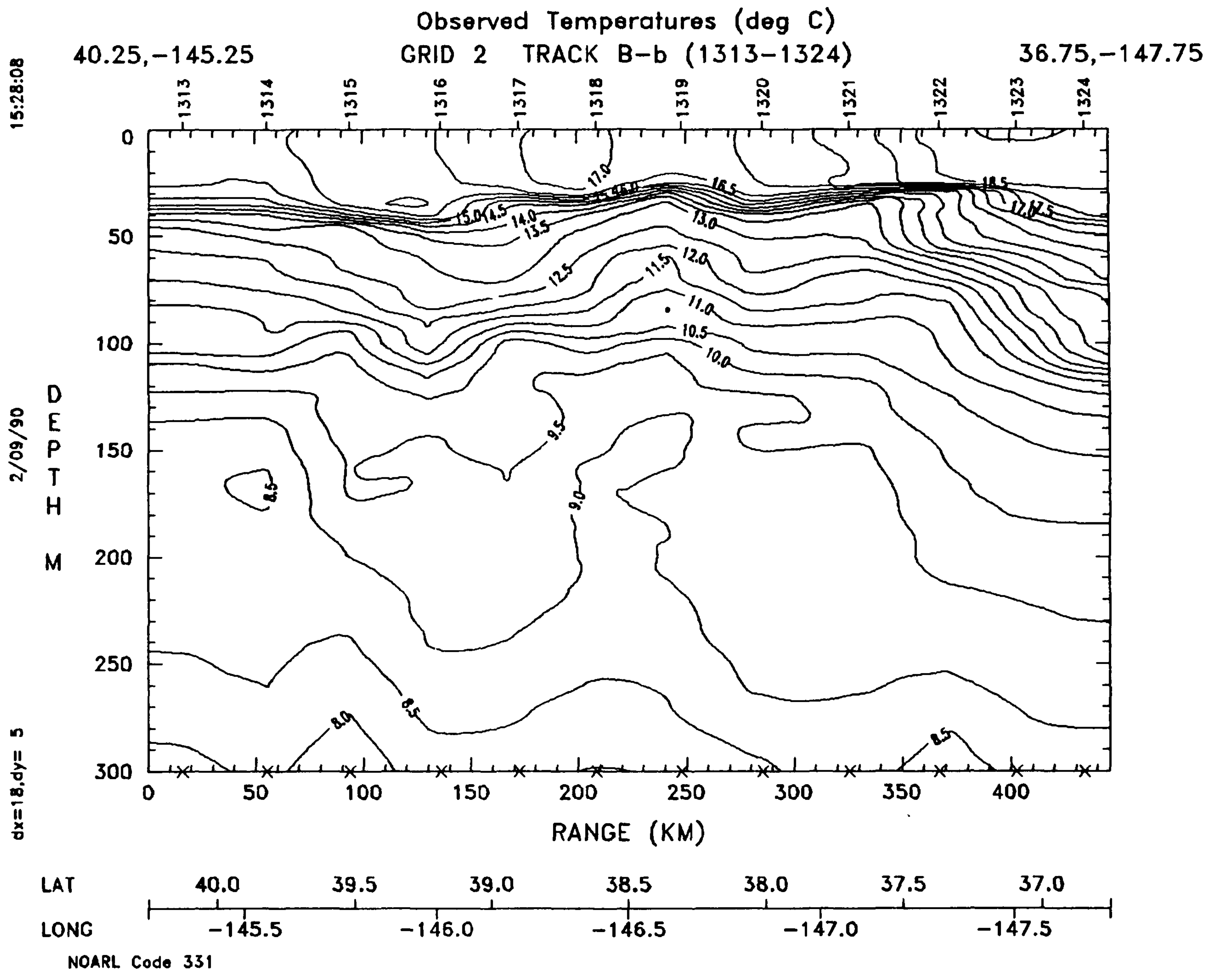

Observed Temperatures (deg C)
39.50,-143.75
GRID 2 TRACK C-a (1406-1414)
35.75,-146.00
15:32:12
2/09/90
dx=19,dy= 5
1414
1413
1412
1411
1410
1409
1408
1407
1406
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
450
LAT
39.5
39.0
38.5
38.0
37.5
37.0
36.5
36.0
LONG
-144.0
-144.5
-145.0
-145.5
-146.0
NOARL Code 331
18.5
18.0
17.5
17.0
16.5
16.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5



Observed Temperatures (deg C)
39.75,-144.25
GRID 2 TRACK B-d (1337-1405)
36.00,-146.50
1337
1338
1339
1341
1340
1401
1402
1403
1404
1405
DEPTH M
0
50
100
150
200
250
300
15.5
17.0
17.5
18.5
18.0
16.5
15.0
14.5
16.0
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
8.5
9.0
8.0
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT
39.5
39.0
38.5
38.0
37.5
37.0
36.5
36.0
LONG
-144.5
-145.0
-145.5
-146.0
-146.5
NOARL Code 331
15:30:51
2/09/90
dx=19,dy= 5



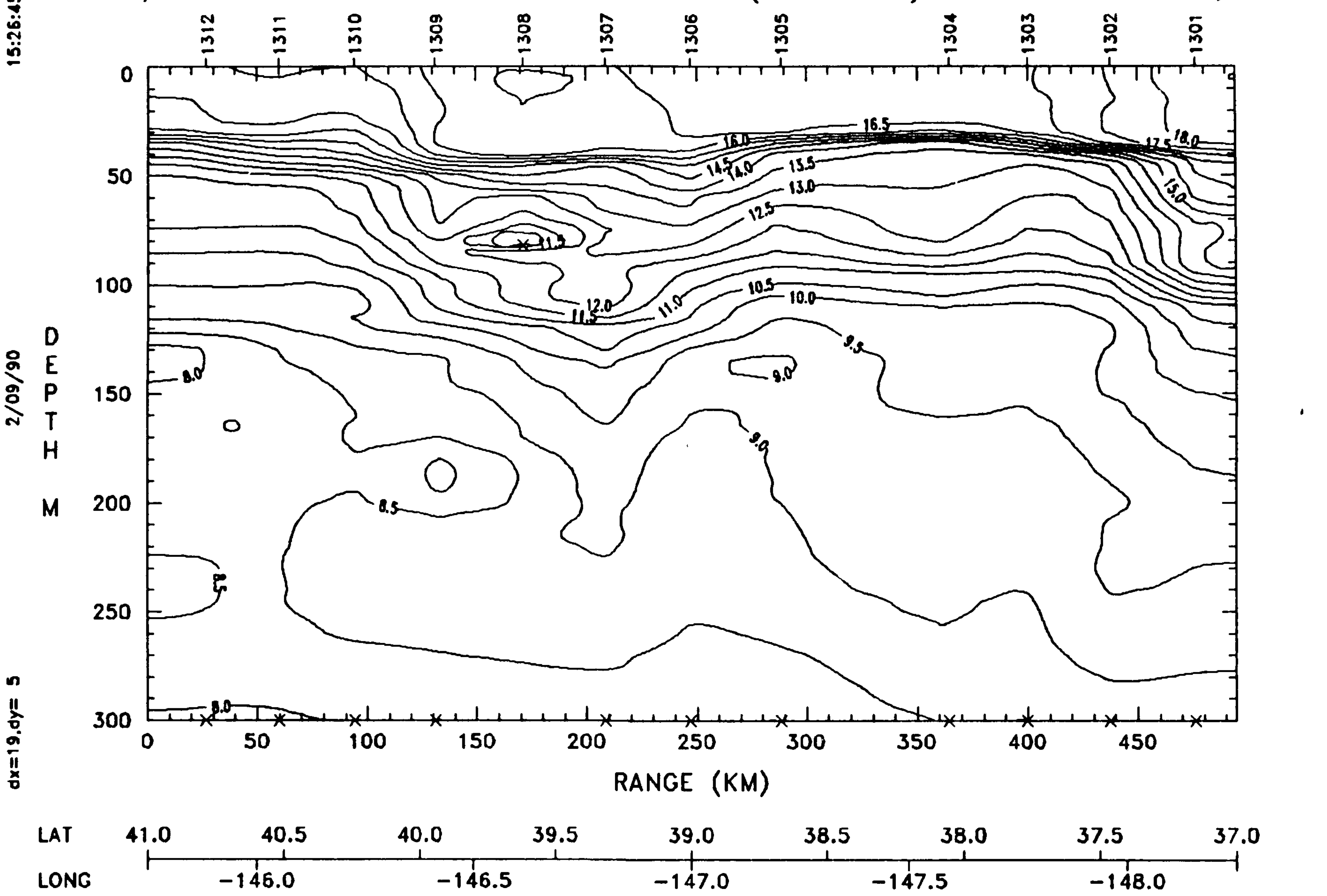
Observed Temperatures (deg C)
40.00,-144.75
GRID 2 TRACK B-c (1325-1336)
36.25,-147.25
15:29:28
2/09/90
dx=19,dy= 5
1336 1335 1334 1333 1332 1331 1330 1329 1328 1327 1326 1325
DEPTH M
0 50 100 150 200 250 300
RANGE (KM)
0 50 100 150 200 250 300 350 400 450
LAT 40.0 39.5 39.0 38.5 38.0 37.5 37.0 36.5
LONG -145.0 -145.5 -146.0 -146.5 -147.0
NOARL Code 331



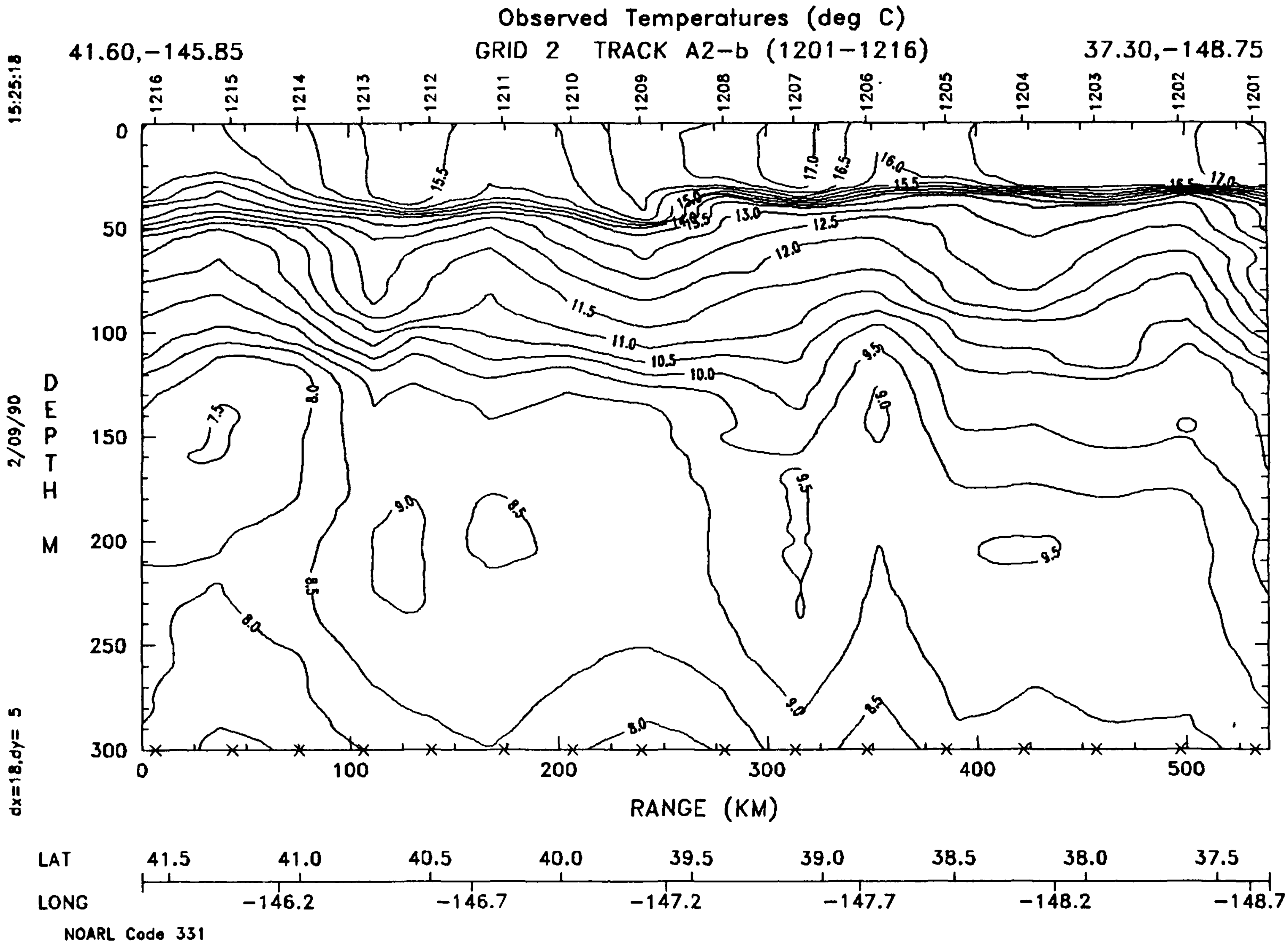
Observed Temperatures (deg C)
40.25,-145.25
GRID 2 TRACK B-b (1313-1324)
36.75,-147.75
15:28:08
2/09/90
dx=18,dy= 5
1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324
DEPTH M
0 50 100 150 200 250 300
RANGE (KM)
0 50 100 150 200 250 300 350 400
LAT 40.0 39.5 39.0 38.5 38.0 37.5 37.0
LONG -145.5 -146.0 -146.5 -147.0 -147.5
NOARL Code 331

Observed Temperatures (deg C)

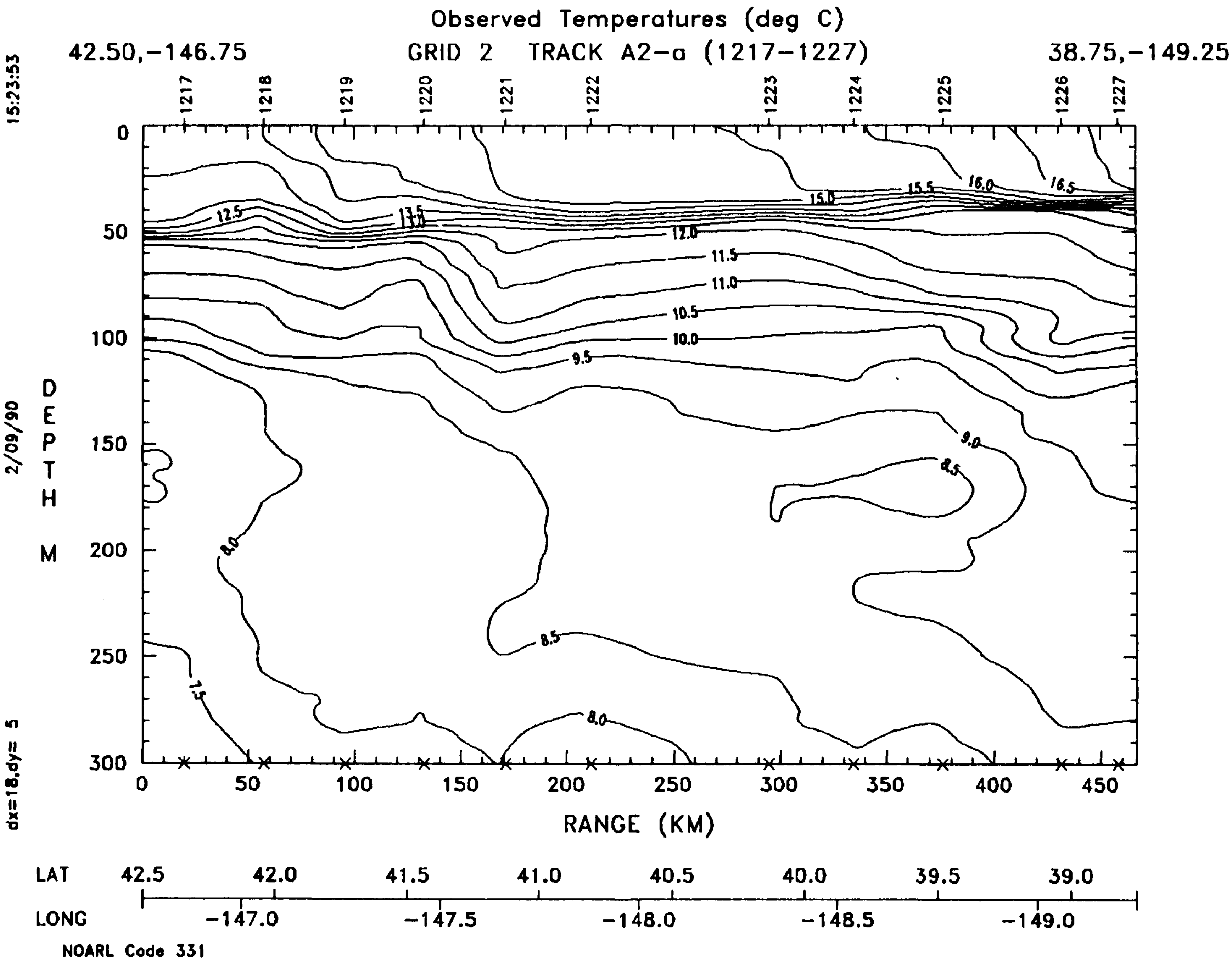
41.00,-145.75 GRID 2 TRACK B-a (1301-1312) 37.00,-148.25

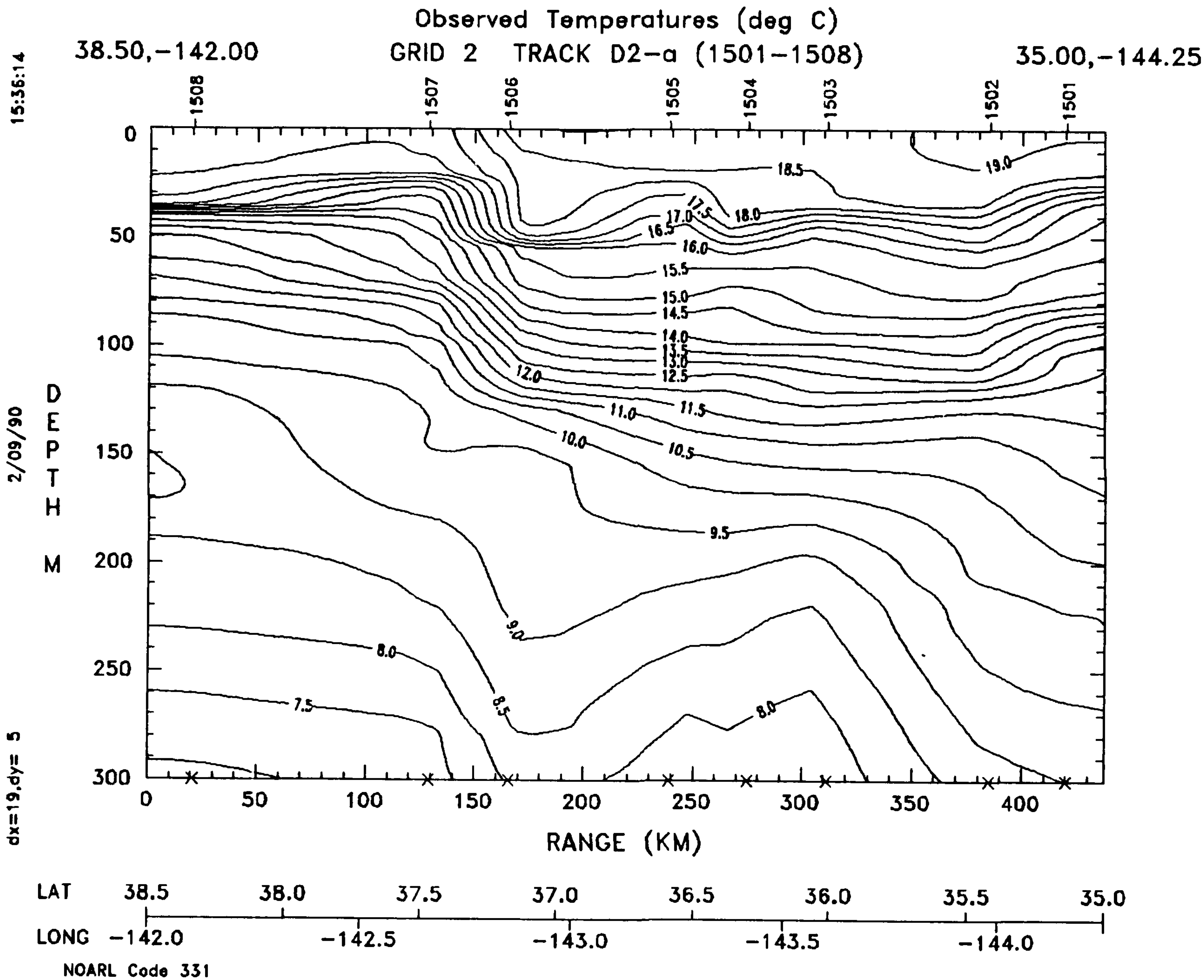


NOARL Code 331

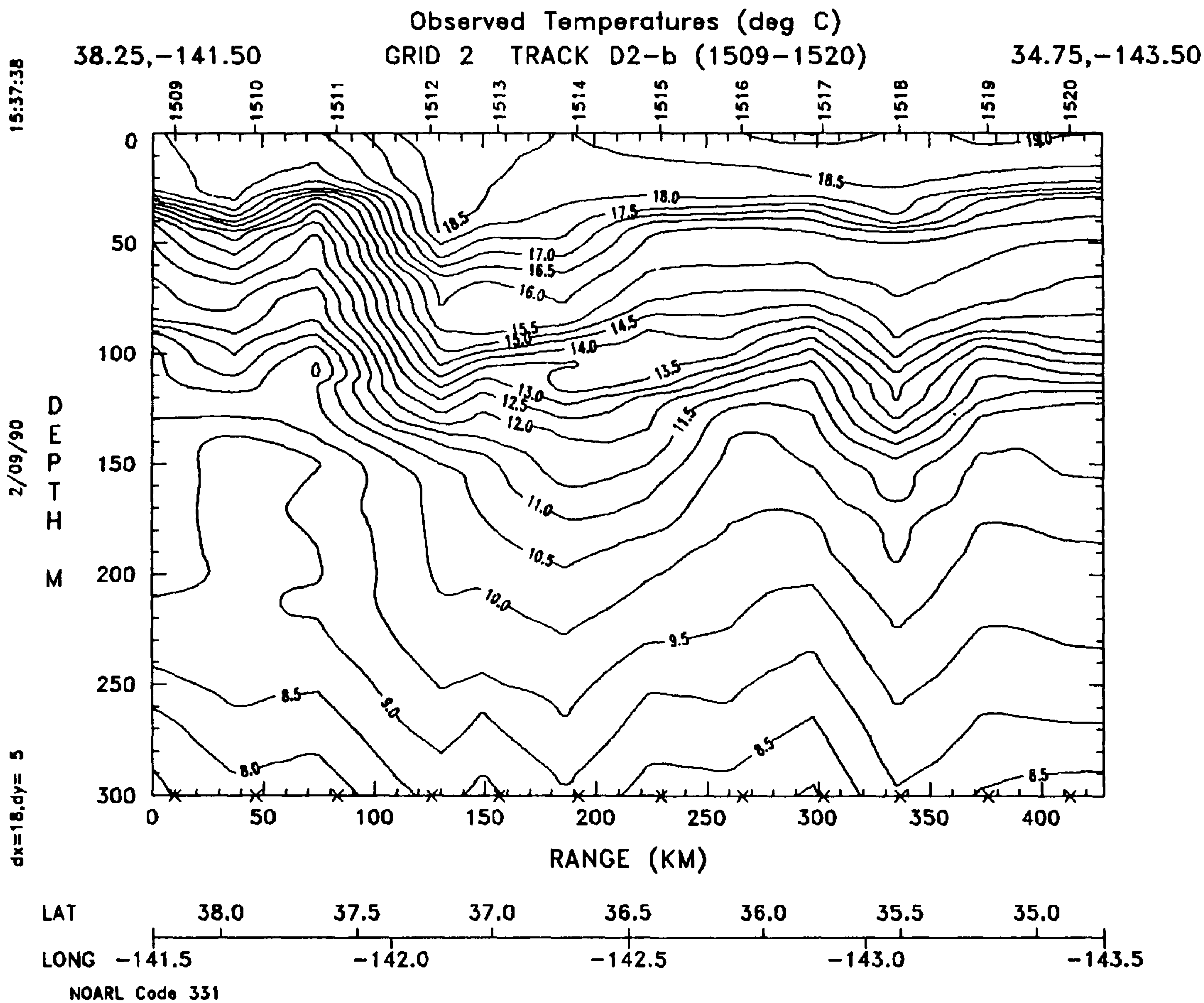


Observed Temperatures (deg C)
41.60,-145.85
GRID 2 TRACK A2-b (1201-1216)
37.30,-148.75
15:25:18
2/09/90
dx=18,dy= 5
1216 1215 1214 1213 1212 1211 1210 1209 1208 1207 1206 1205 1204 1203 1202 1201
DEPTH M
0 50 100 150 200 250 300
RANGE (KM)
0 100 200 300 400 500
LAT
41.5 41.0 40.5 40.0 39.5 39.0 38.5 38.0 37.5
LONG
-146.2 -146.7 -147.2 -147.7 -148.2 -148.7
NOARL Code 331

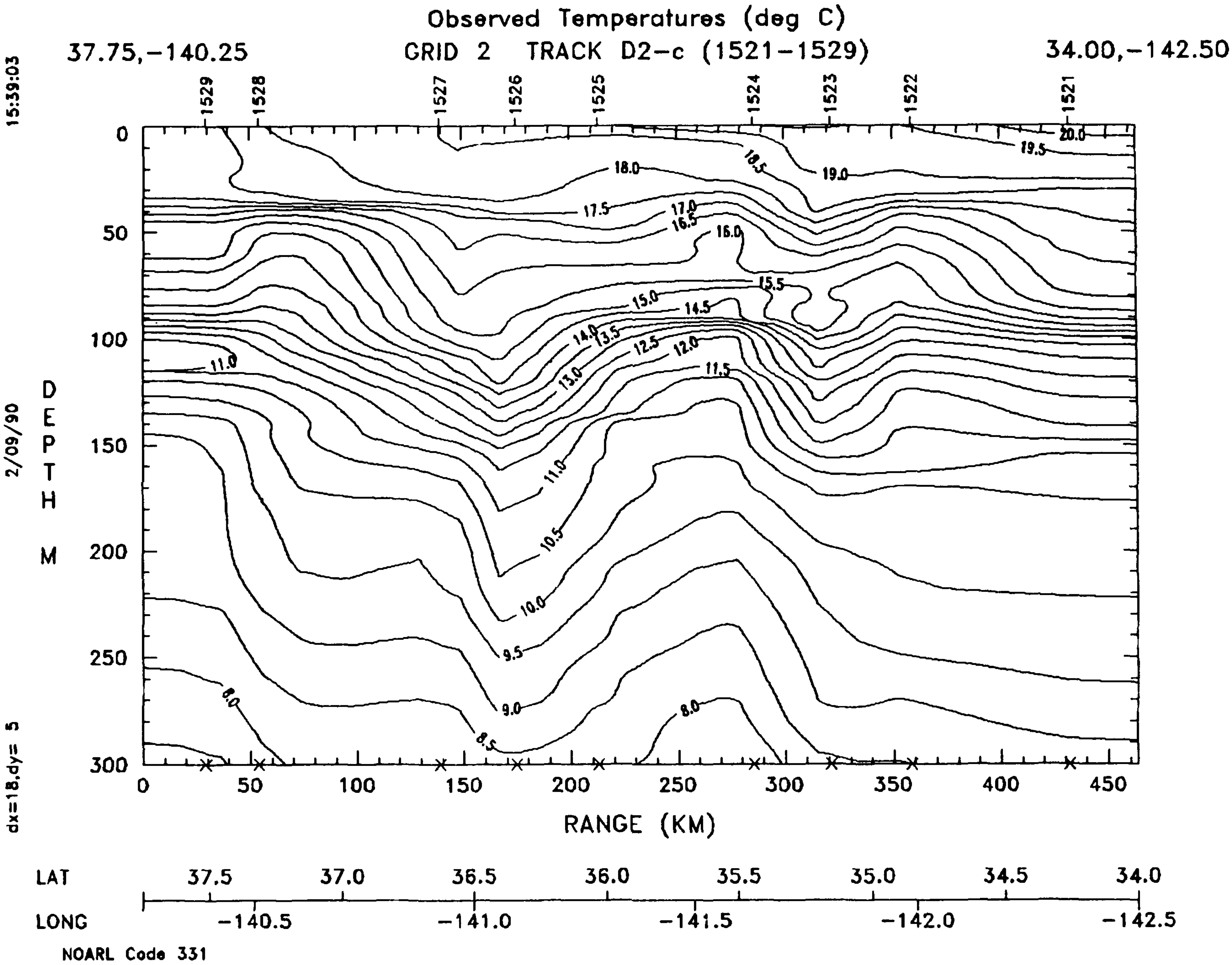

Observed Temperatures (deg C)
42.50,-146.75
GRID 2 TRACK A2-a (1217-1227)
38.75,-149.25
15:23:53
2/09/90
dx=18,dy= 5
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331



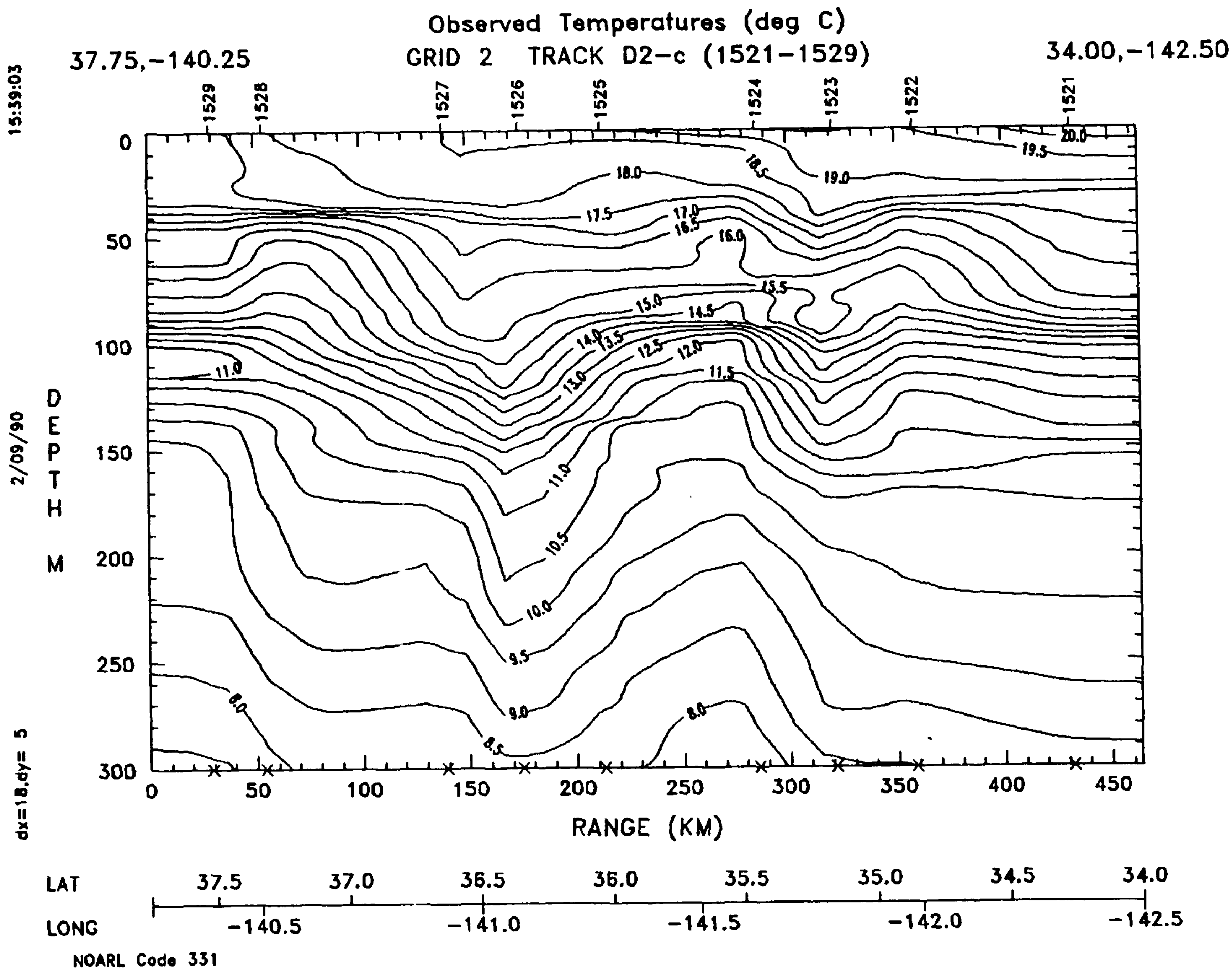
Observed Temperatures (deg C)
38.50,-142.00
GRID 2 TRACK D2-a (1501-1508)
35.00,-144.25
15:36:14
2/09/90
dx=19,dy= 5
1508
1507
1506
1505
1504
1503
1502
1501
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
0
50
100
150
200
250
300
350
400
18.5
19.0
17.5
18.0
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.0
11.5
10.0
10.5
9.5
9.0
8.0
8.5
7.5
8.0
LAT 38.5 38.0 37.5 37.0 36.5 36.0 35.5 35.0
LONG -142.0 -142.5 -143.0 -143.5 -144.0
NOARL Code 331



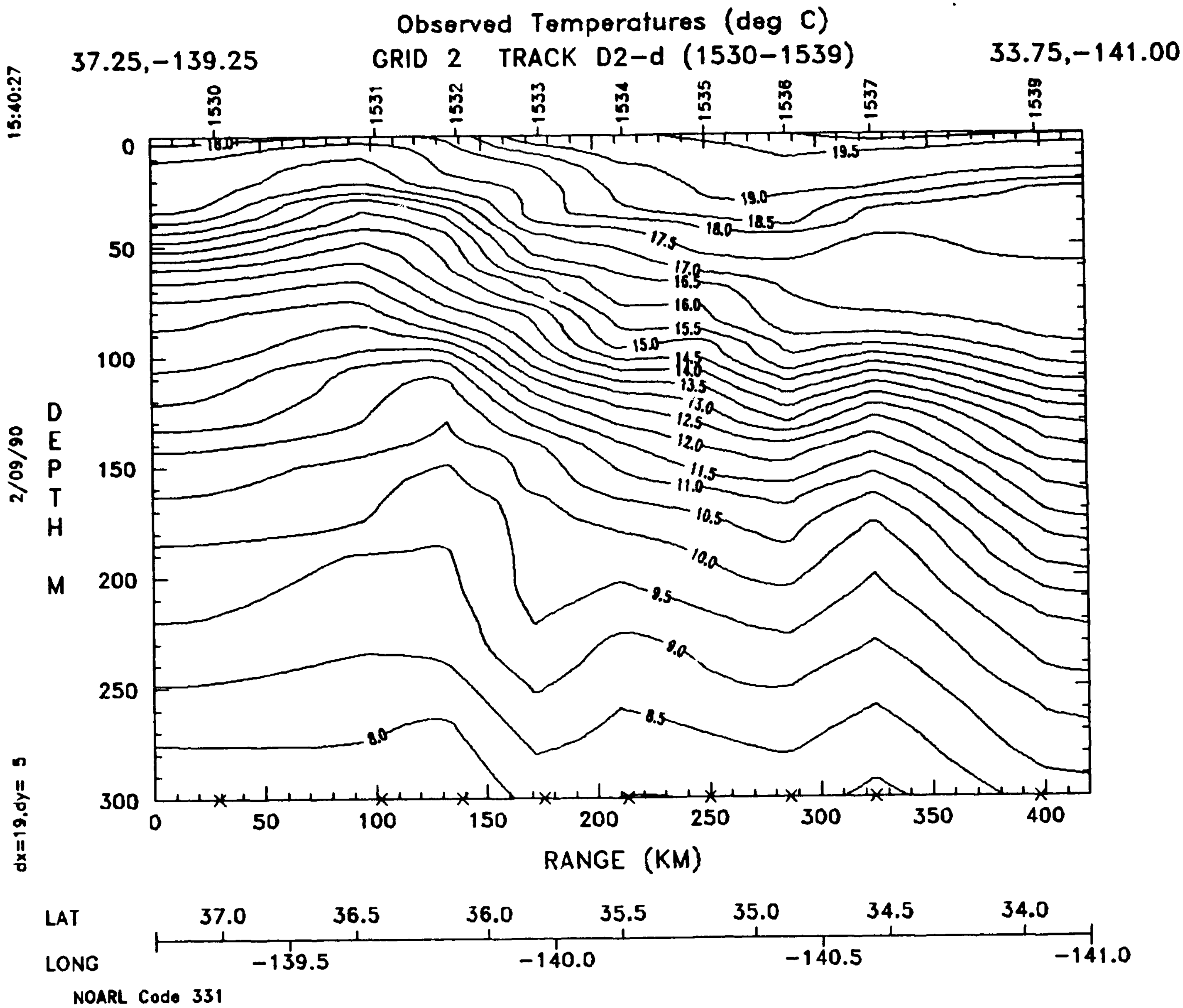
Observed Temperatures (deg C)
38.25,-141.50
GRID 2 TRACK D2-b (1509-1520)
34.75,-143.50
1509 1510 1511 1512 1513 1514 1515 1516 1517 1518 1519 1520
DEPTH M
RANGE (KM)
LAT
LONG
15:37:38
2/09/90
dx=18,dy= 5
NOARL Code 331



Observed Temperatures (deg C)
37.75,-140.25
GRID 2 TRACK D2-c (1521-1529)
34.00,-142.50
15:39:03
2/09/90
dx=18,dy= 5
1529
1528
1527
1526
1525
1524
1523
1522
1521
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
0
50
100
150
200
250
300
350
400
450
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
8.0
LAT
37.5
37.0
36.5
36.0
35.5
35.0
34.5
34.0
LONG
-140.5
-141.0
-141.5
-142.0
-142.5
NOARL Code 331



Observed Temperatures (deg C)
GRID 2 TRACK D2-c (1521-1529)
37.75,-140.25
34.00,-142.50
15:39:03
2/09/90
dx=18,dy= 5
1529
1528
1527
1526
1525
1524
1523
1522
1521
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
0
50
100
150
200
250
300
350
400
450
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
8.0
LAT
37.5
37.0
36.5
36.0
35.5
35.0
34.5
34.0
LONG
-140.5
-141.0
-141.5
-142.0
-142.5
NOARL Code 331


Observed Temperatures (deg C)
37.25,-139.25
GRID 2 TRACK D2-d (1530-1539)
33.75,-141.00
1530
1531
1532
1533
1534
1535
1536
1537
1539
15:40:27
2/09/90
dx=19,dy= 5
DEPTH M
0
50
100
150
200
250
300
18.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
0
50
100
150
200
250
300
350
400
RANGE (KM)
LAT
37.0
36.5
36.0
35.5
35.0
34.5
34.0
LONG
-139.5
-140.0
-140.5
-141.0
NOARL Code 331

Appendix I.

NEPAC Grid 2 (6 - 7 July 1989)

Temperature Contours along Selected Vertical Transects

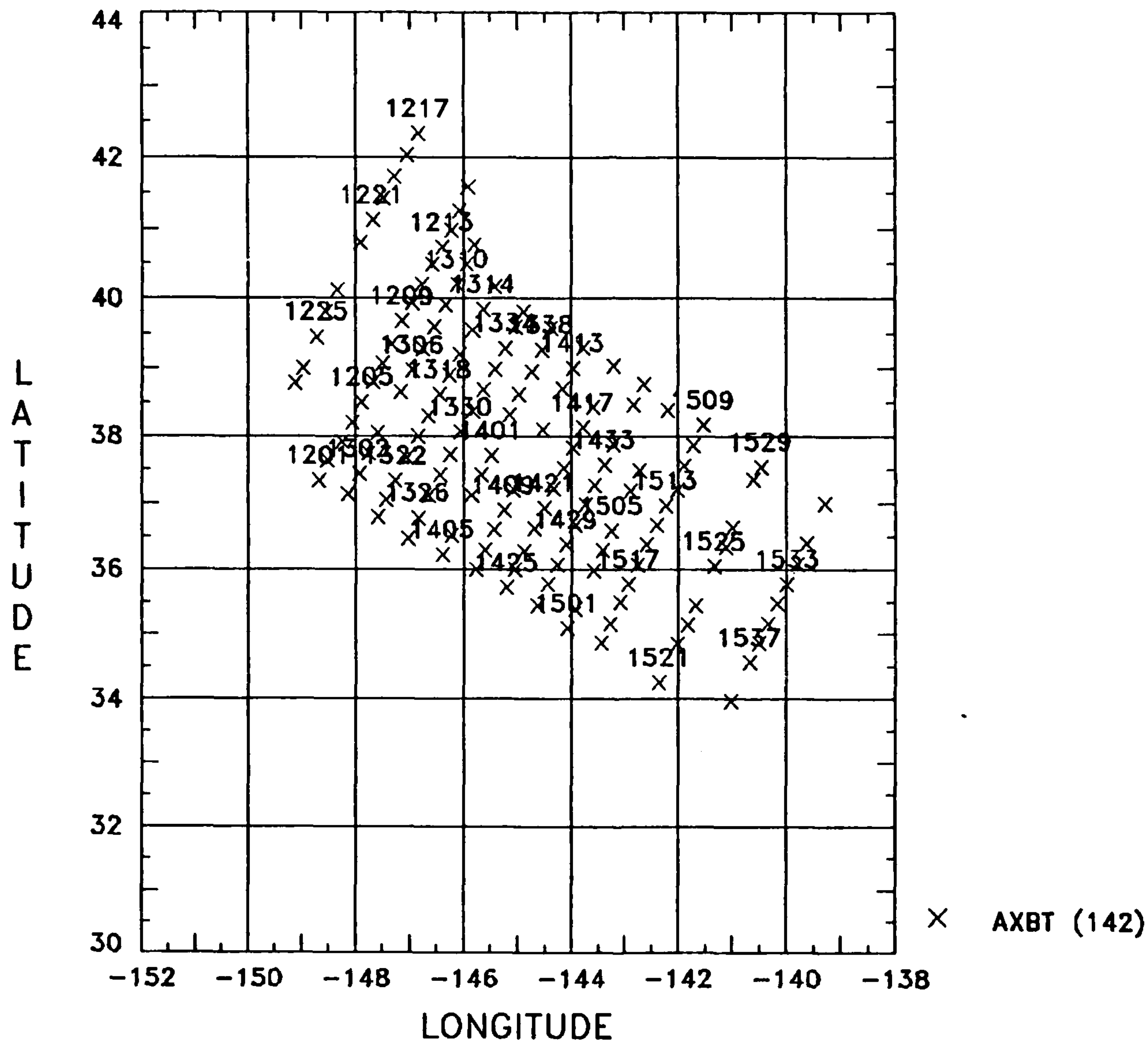
Surface to 5500 m

8:55:51

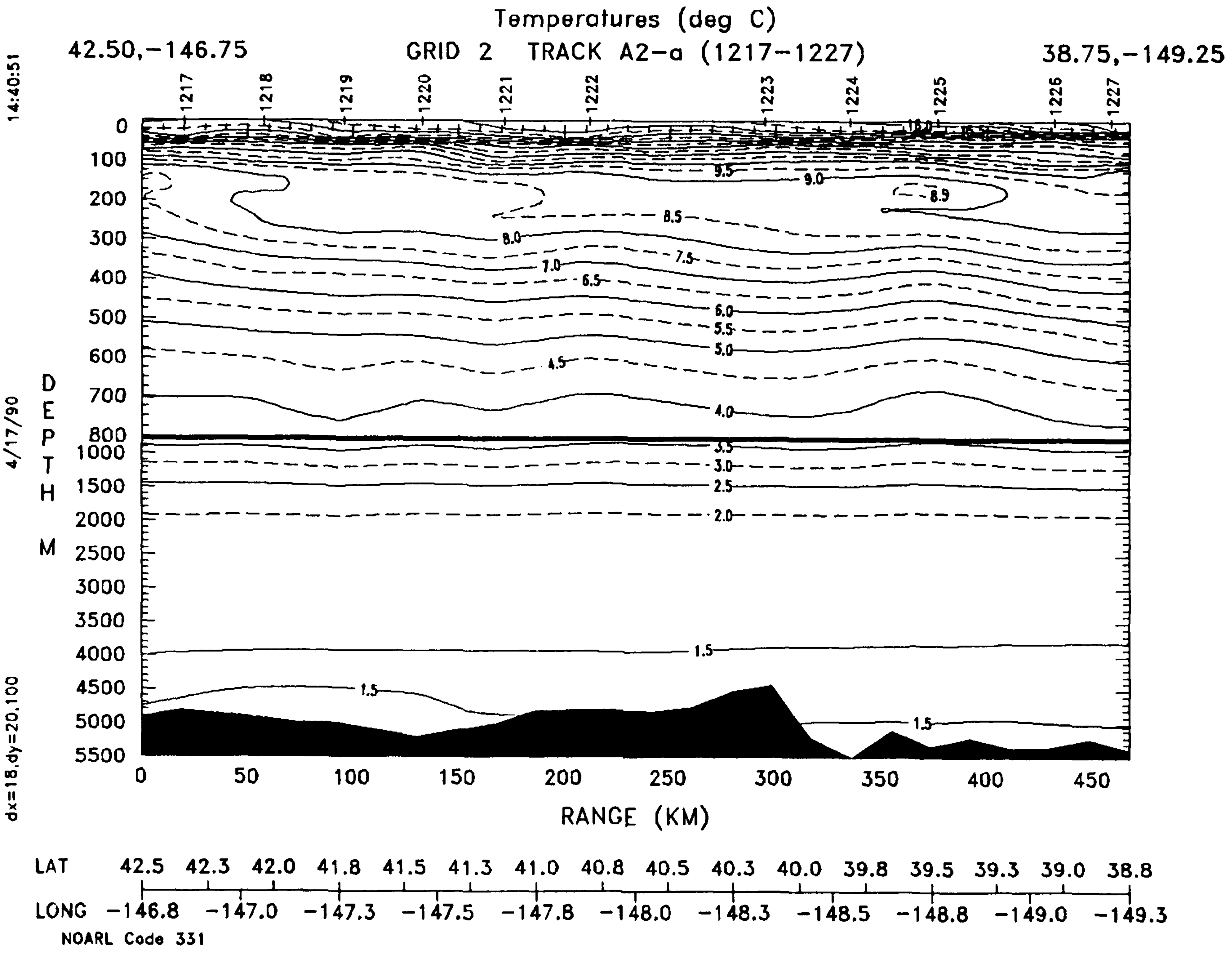
5/09/90

NEPAC Grid 2 (6–7 July 1989)

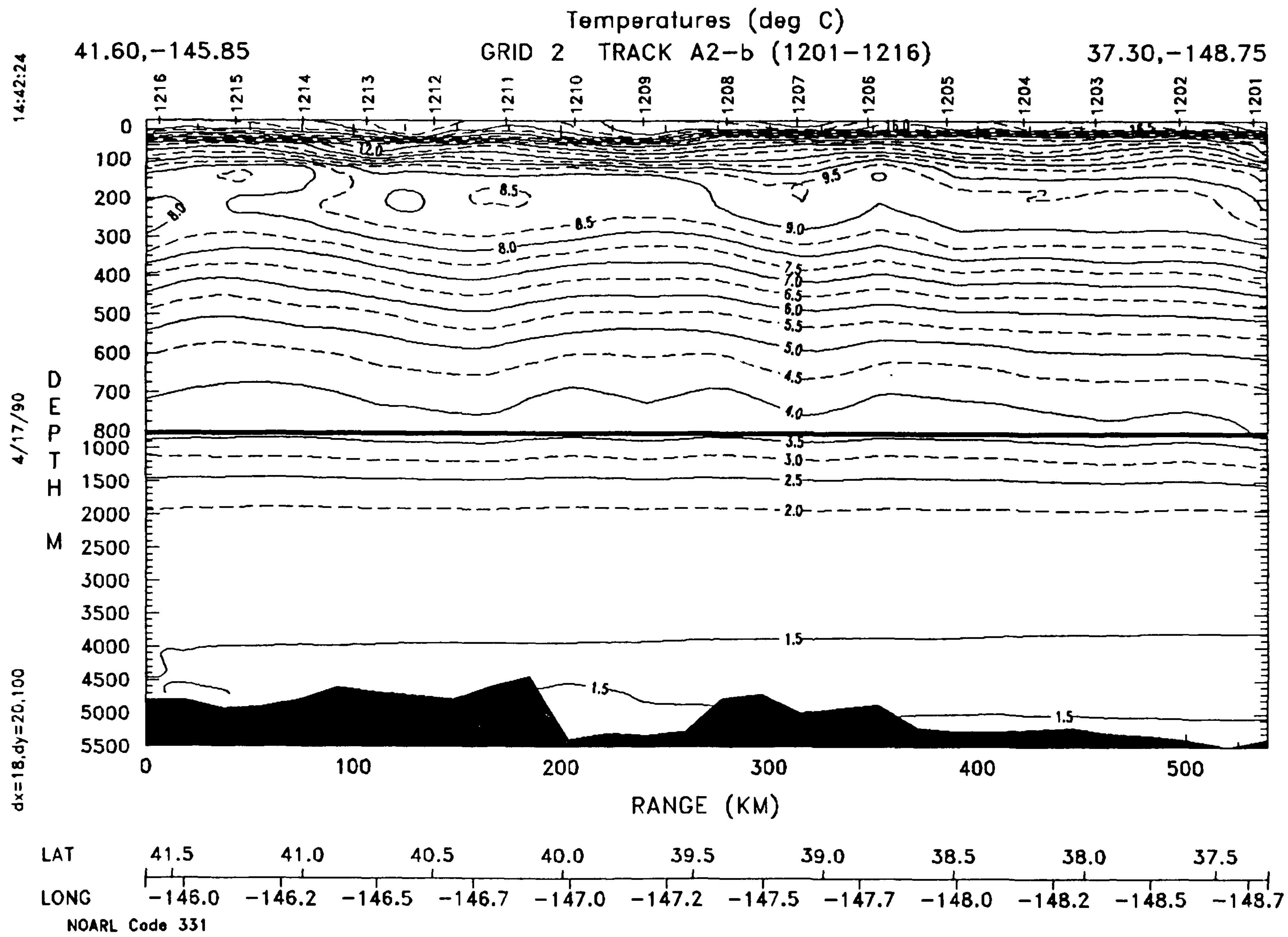
142 Probes



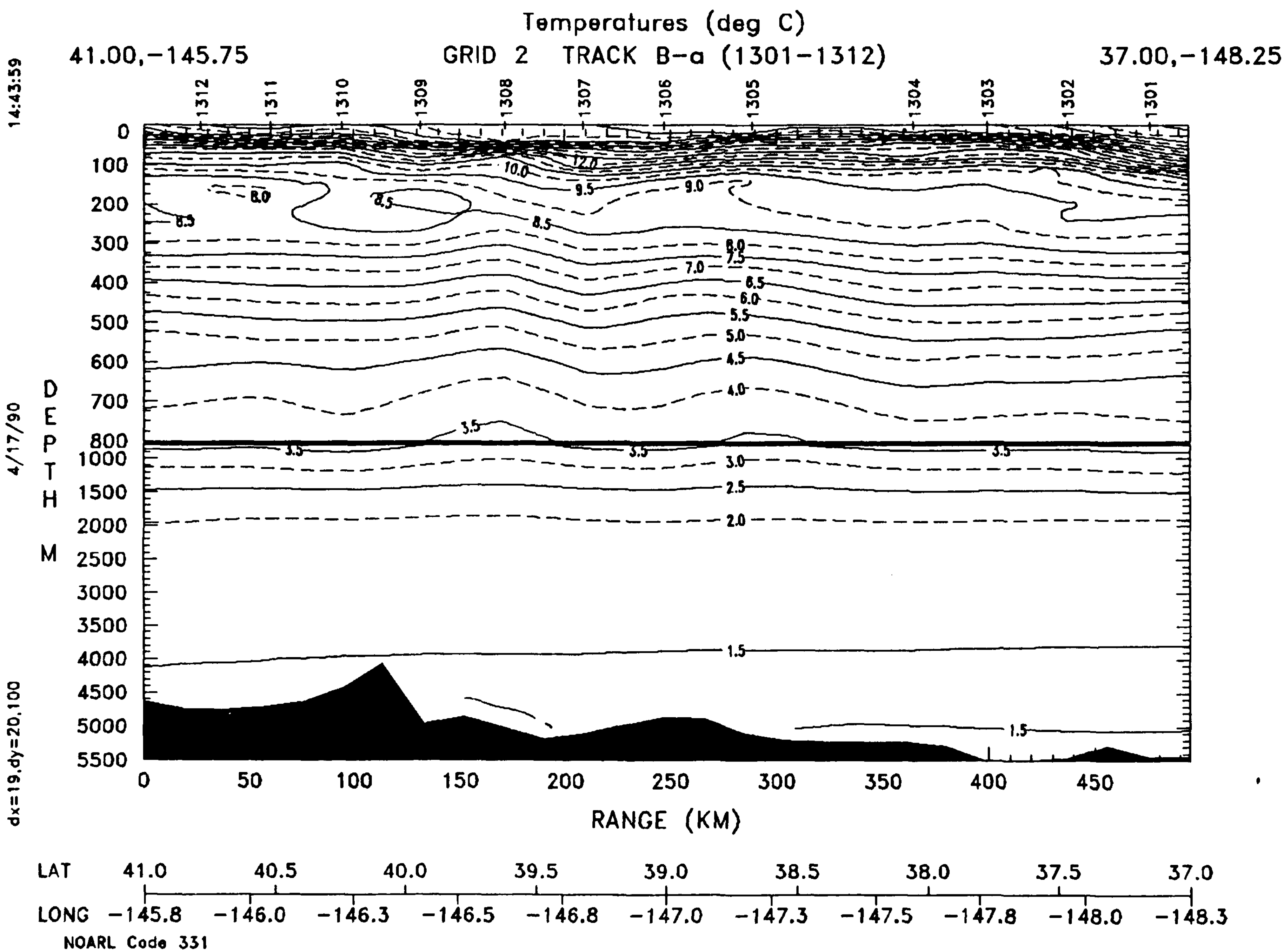
NOARL Code 331

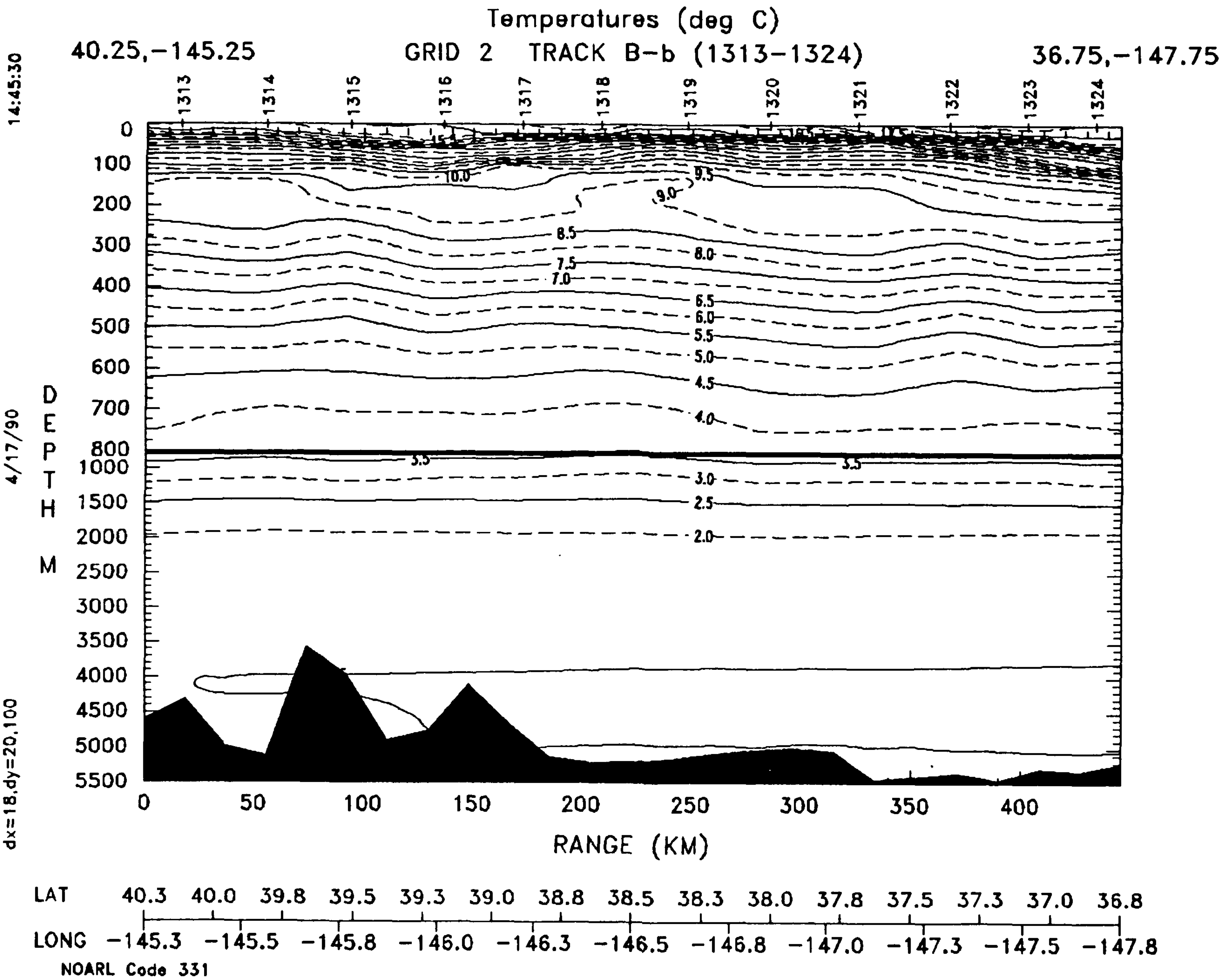


Temperatures (deg C)
42.50,-146.75
GRID 2 TRACK A2-a (1217-1227)
38.75,-149.25
14:40:51
4/17/90
dx=18,dy=20,100
1217
1218
1219
1220
1221
1222
1223
1224
1225
1226
1227
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
9.5
9.0
8.9
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
RANGE (KM)
0
50
100
150
200
250
300
350
400
450
LAT 42.5 42.3 42.0 41.8 41.5 41.3 41.0 40.8 40.5 40.3 40.0 39.8 39.5 39.3 39.0 38.8
LONG -146.8 -147.0 -147.3 -147.5 -147.8 -148.0 -148.3 -148.5 -148.8 -149.0 -149.3
NOARL Code 331

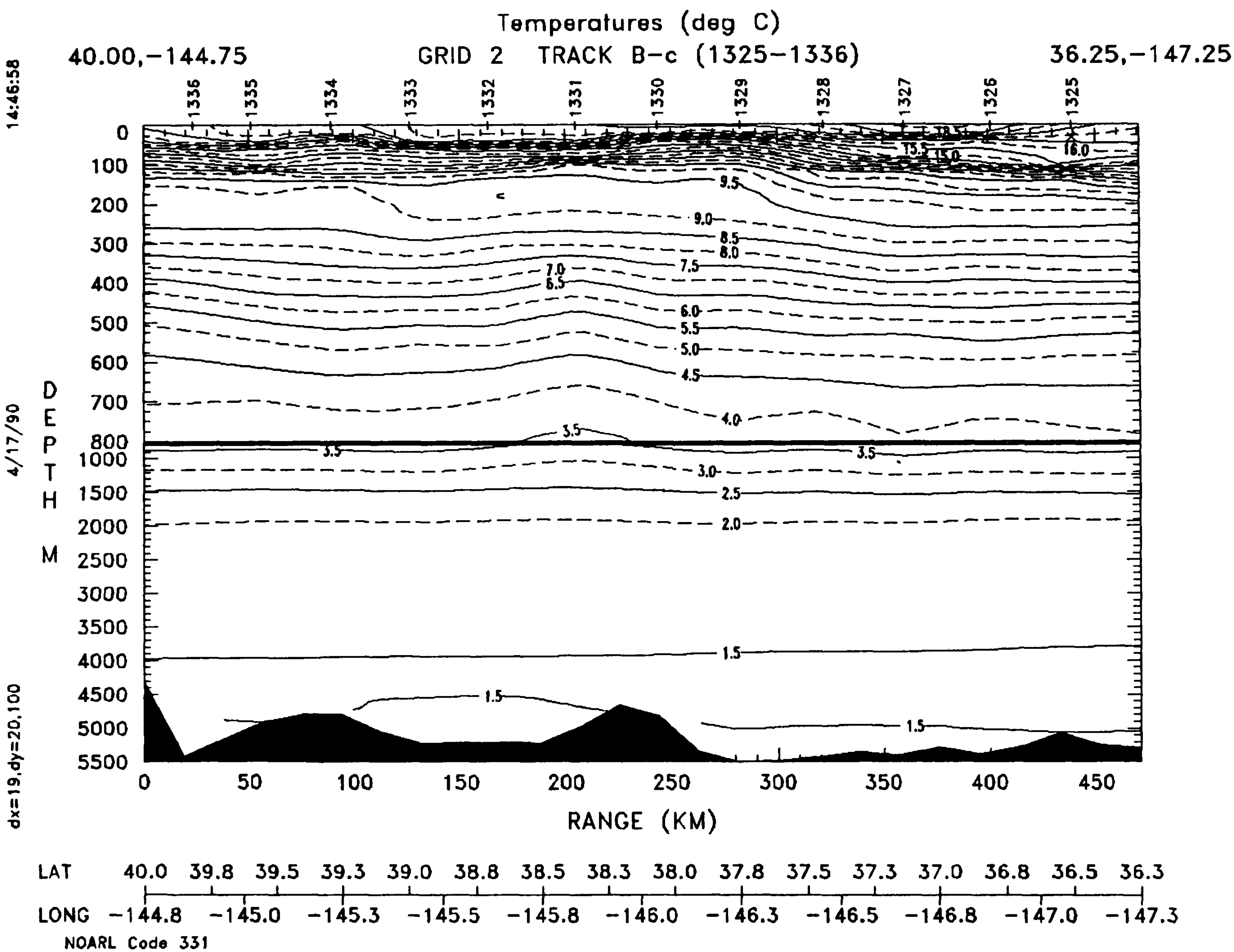


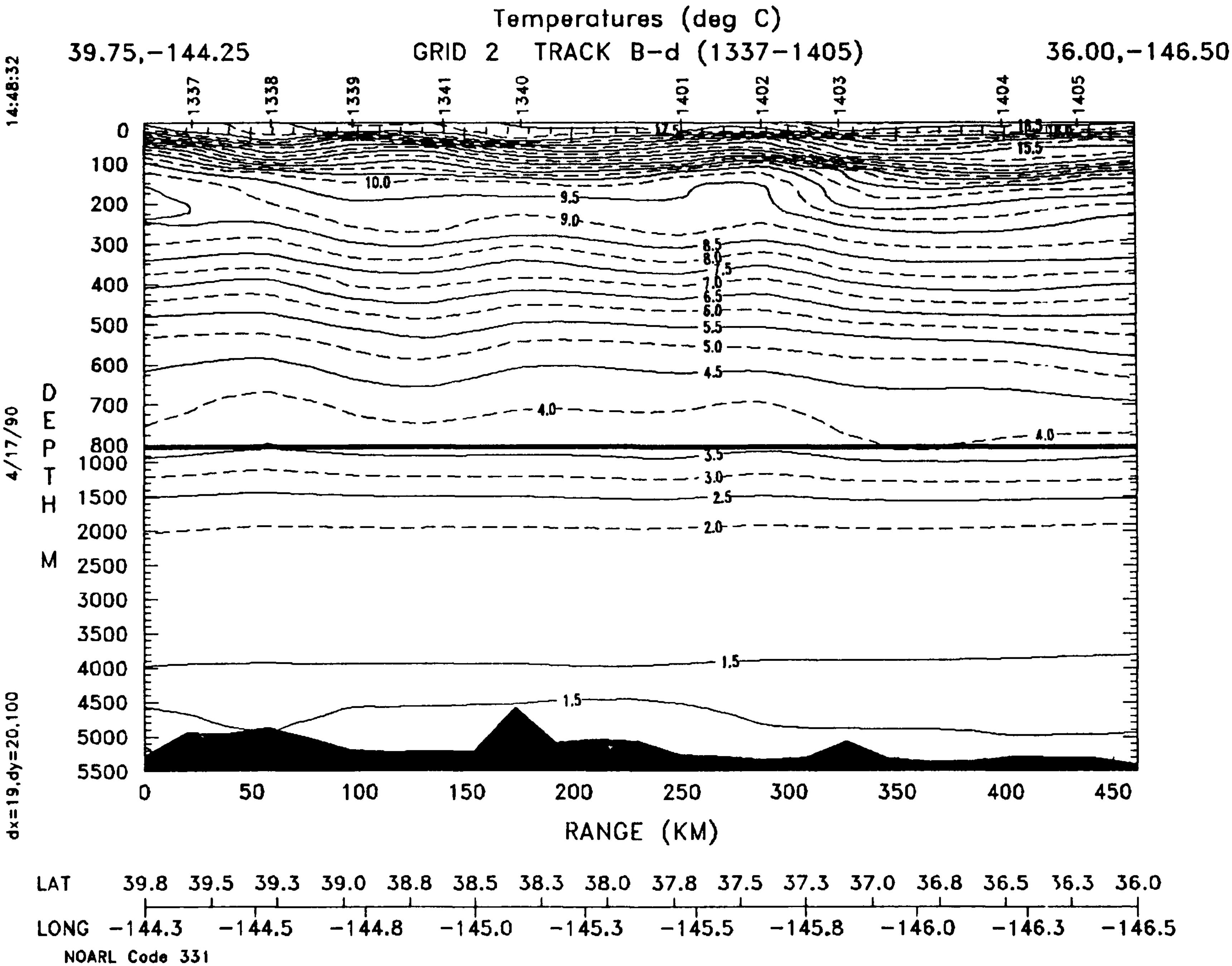
Temperatures (deg C)
41.60,-145.85
GRID 2 TRACK A2-b (1201-1216)
37.30,-148.75
14:42:24
4/17/90
dx=18,dy=20,100
1216 1215 1214 1213 1212 1211 1210 1209 1208 1207 1206 1205 1204 1203 1202 1201
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
12.0
9.5
8.5
8.0
9.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
RANGE (KM)
0 100 200 300 400 500
LAT 41.5 41.0 40.5 40.0 39.5 39.0 38.5 38.0 37.5
LONG -146.0 -146.2 -146.5 -146.7 -147.0 -147.2 -147.5 -147.7 -148.0 -148.2 -148.5 -148.7
NOARL Code 331

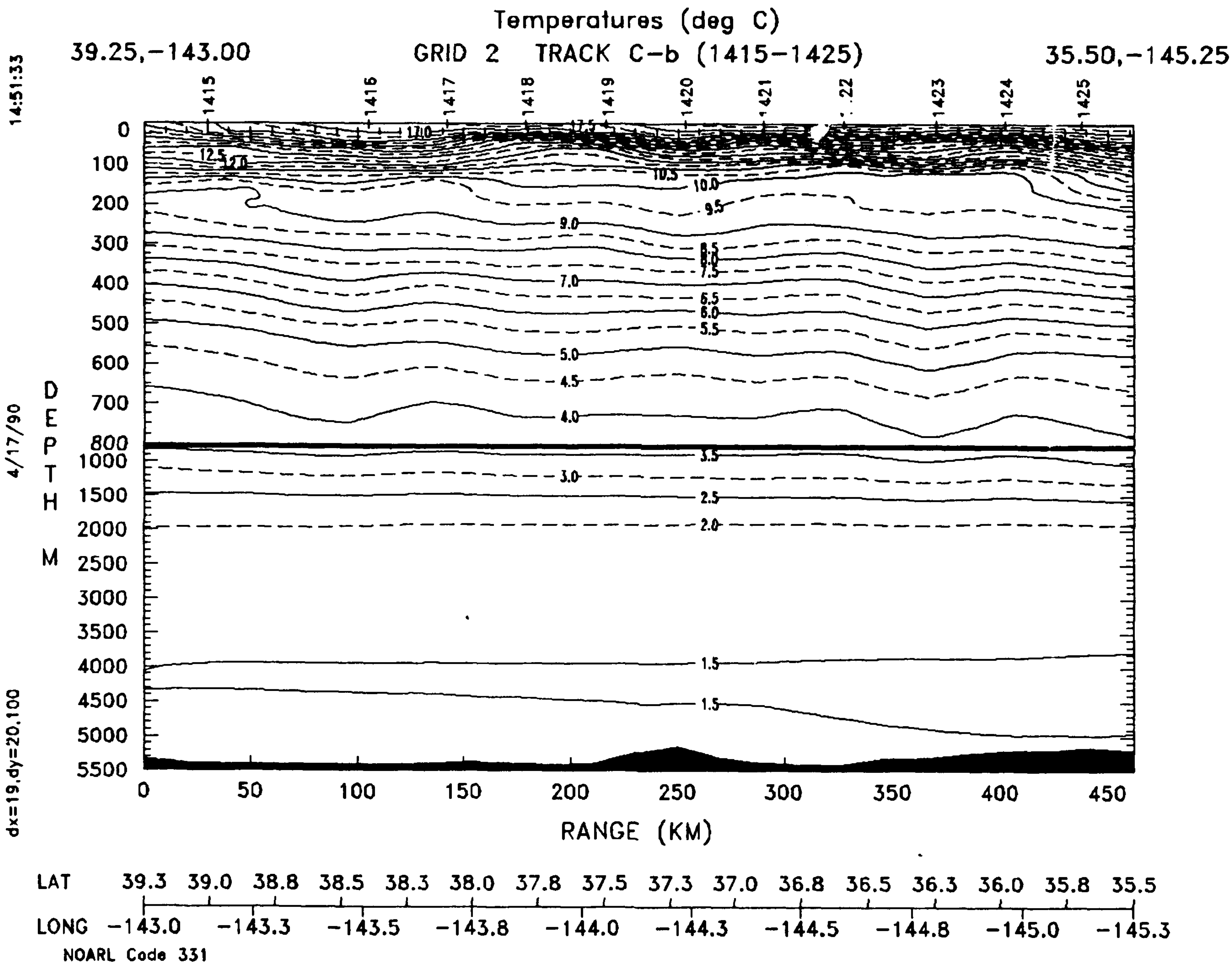

Temperatures (deg C)
41.00,-145.75
GRID 2 TRACK B-a (1301-1312)
37.00,-148.25
14:43:59
4/17/90
dx=19,dy=20,100
1312
1311
1310
1309
1308
1307
1306
1305
1304
1303
1302
1301
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
12.0
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT 41.0 40.5 40.0 39.5 39.0 38.5 38.0 37.5 37.0
LONG -145.8 -146.0 -146.3 -146.5 -146.8 -147.0 -147.3 -147.5 -147.8 -148.0 -148.3
NOARL Code 331



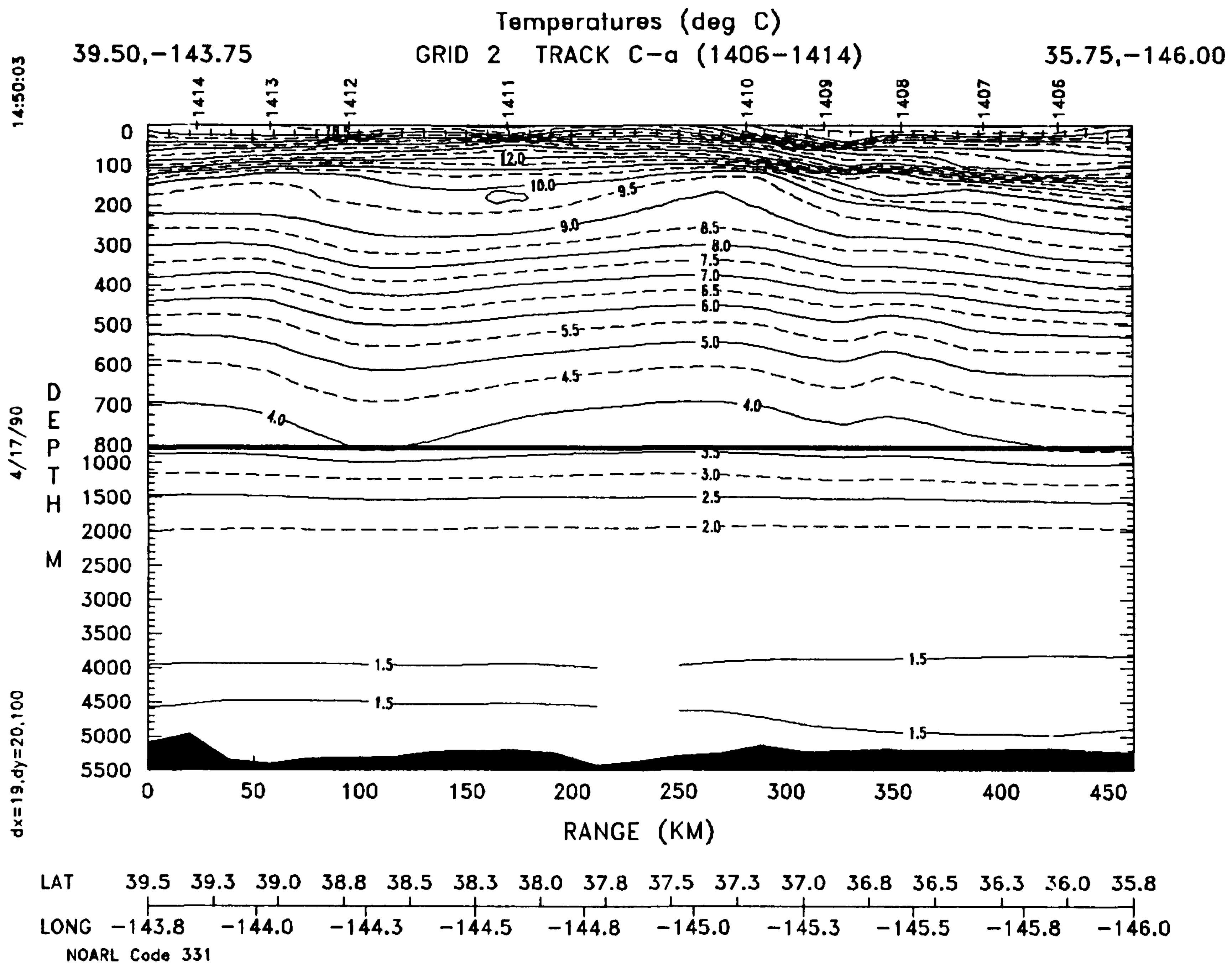
Temperatures (deg C)
40.25,-145.25
GRID 2 TRACK B-b (1313-1324)
36.75,-147.75
14:45:30
4/17/90
dx=18,dy=20,100
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
0
50
100
150
200
250
300
350
400
RANGE (KM)
LAT
40.3
40.0
39.8
39.5
39.3
39.0
38.8
38.5
38.3
38.0
37.8
37.5
37.3
37.0
36.8
LONG
-145.3
-145.5
-145.8
-146.0
-146.3
-146.5
-146.8
-147.0
-147.3
-147.5
-147.8
NOARL Code 331


Temperatures (deg C)
40.00,-144.75
GRID 2 TRACK B-c (1325-1336)
36.25,-147.25
1336 1335 1334 1333 1332 1331 1330 1329 1328 1327 1326 1325
14:46:58
4/17/90
dx=19,dy=20,100
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
16.0 15.5 15.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 40.0 39.8 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3
LONG -144.8 -145.0 -145.3 -145.5 -145.8 -146.0 -146.3 -146.5 -146.8 -147.0 -147.3
NOARL Code 331

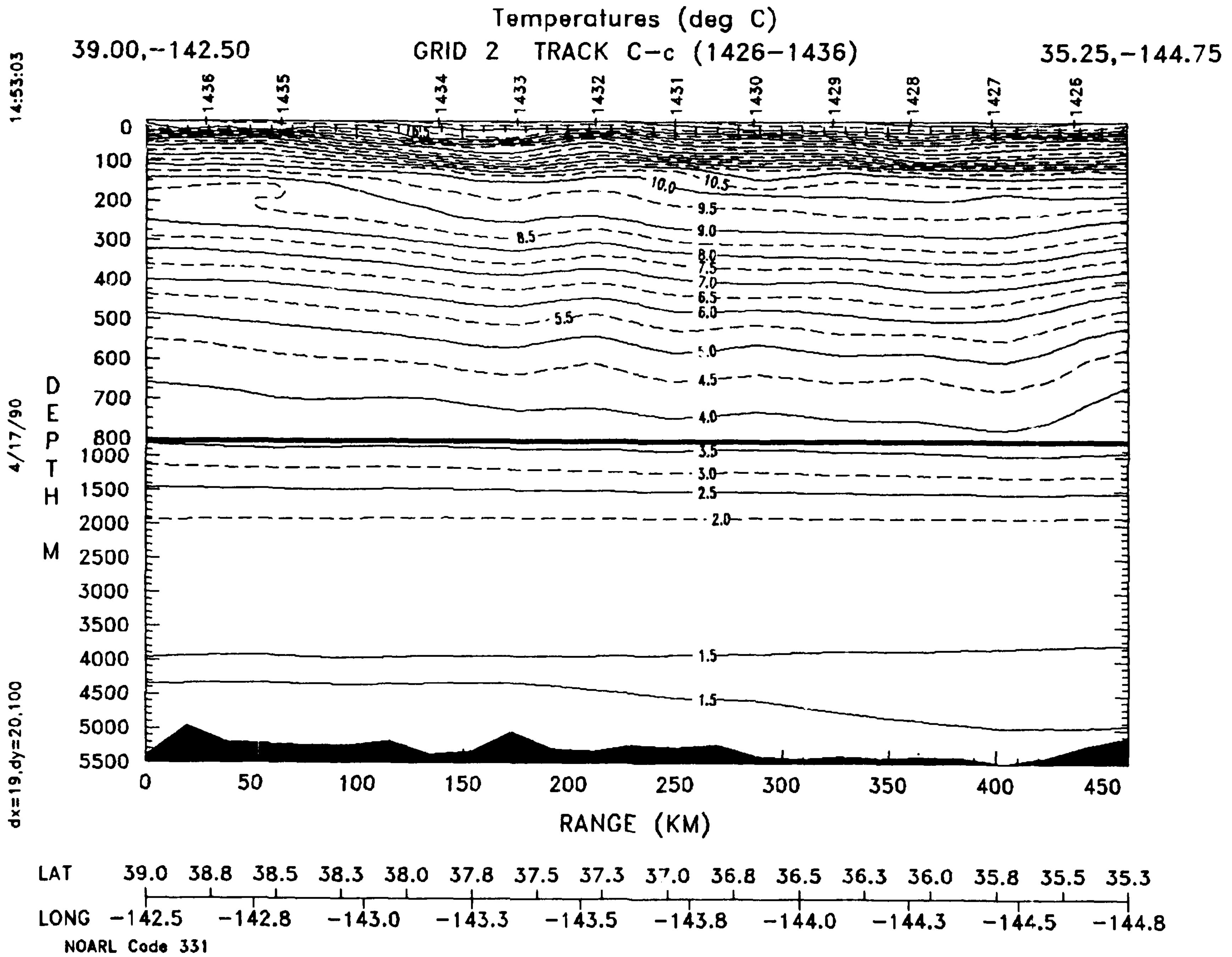

Temperatures (deg C)
39.75,-144.25
GRID 2 TRACK B-d (1337-1405)
36.00,-146.50
14:48:32
4/17/90
dx=19,dy=20.100
1337 1338 1339 1341 1340 1401 1402 1403 1404 1405
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 15.5 17.5
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 39.8 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0
LONG −144.3 −144.5 −144.8 −145.0 −145.3 −145.5 −145.8 −146.0 −146.3 −146.5
NOARL Code 331



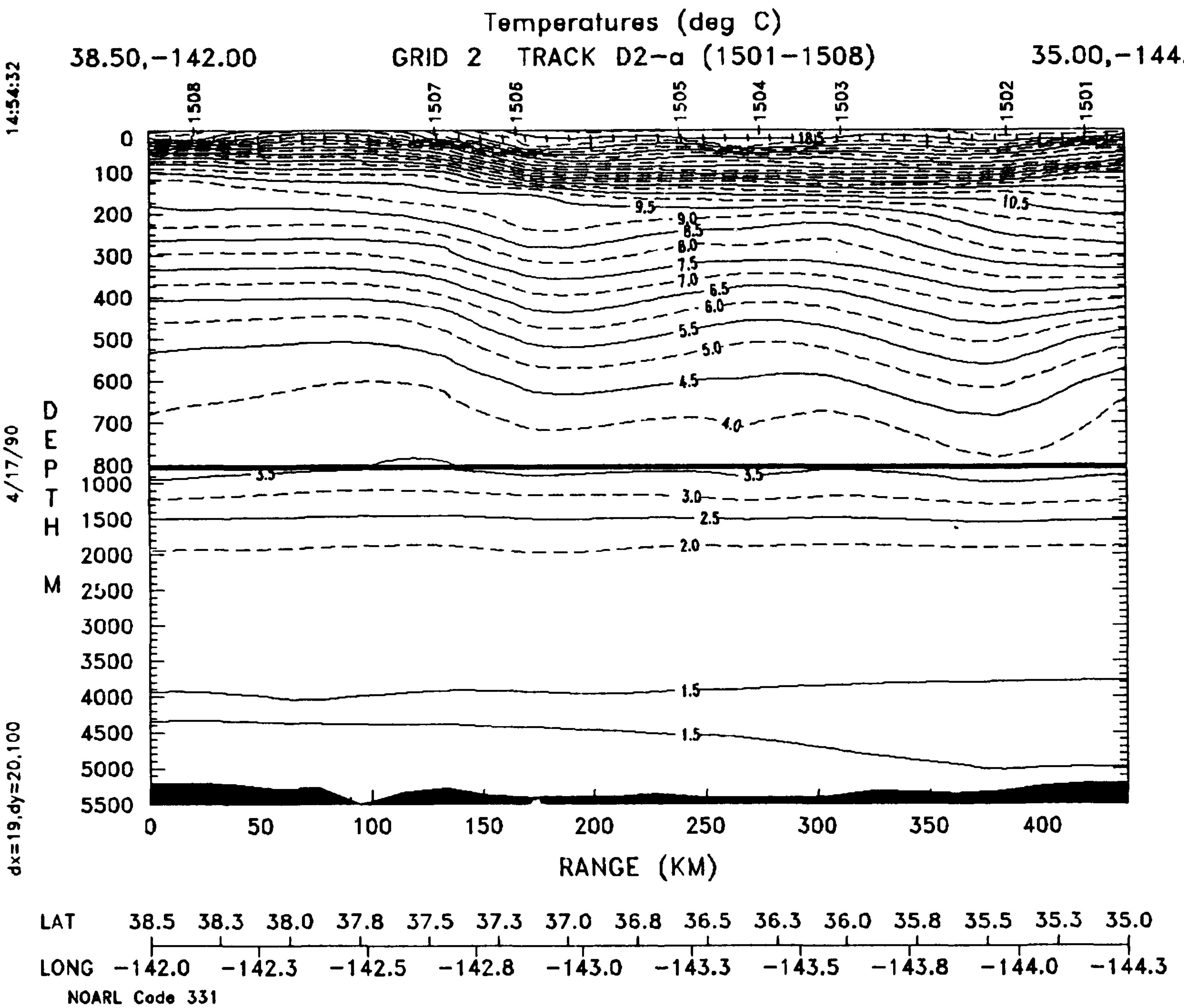
Temperatures (deg C)
39.25,-143.00
GRID 2 TRACK C-b (1415-1425)
35.50,-145.25
14:51:33
4/17/90
dx=19,dy=20.100
1415
1416
1417
1418
1419
1420
1421
1423
1424
1425
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
12.5
12.0
17.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.5
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5
LONG -143.0 -143.3 -143.5 -143.8 -144.0 -144.3 -144.5 -144.8 -145.0 -145.3
NOARL Code 331



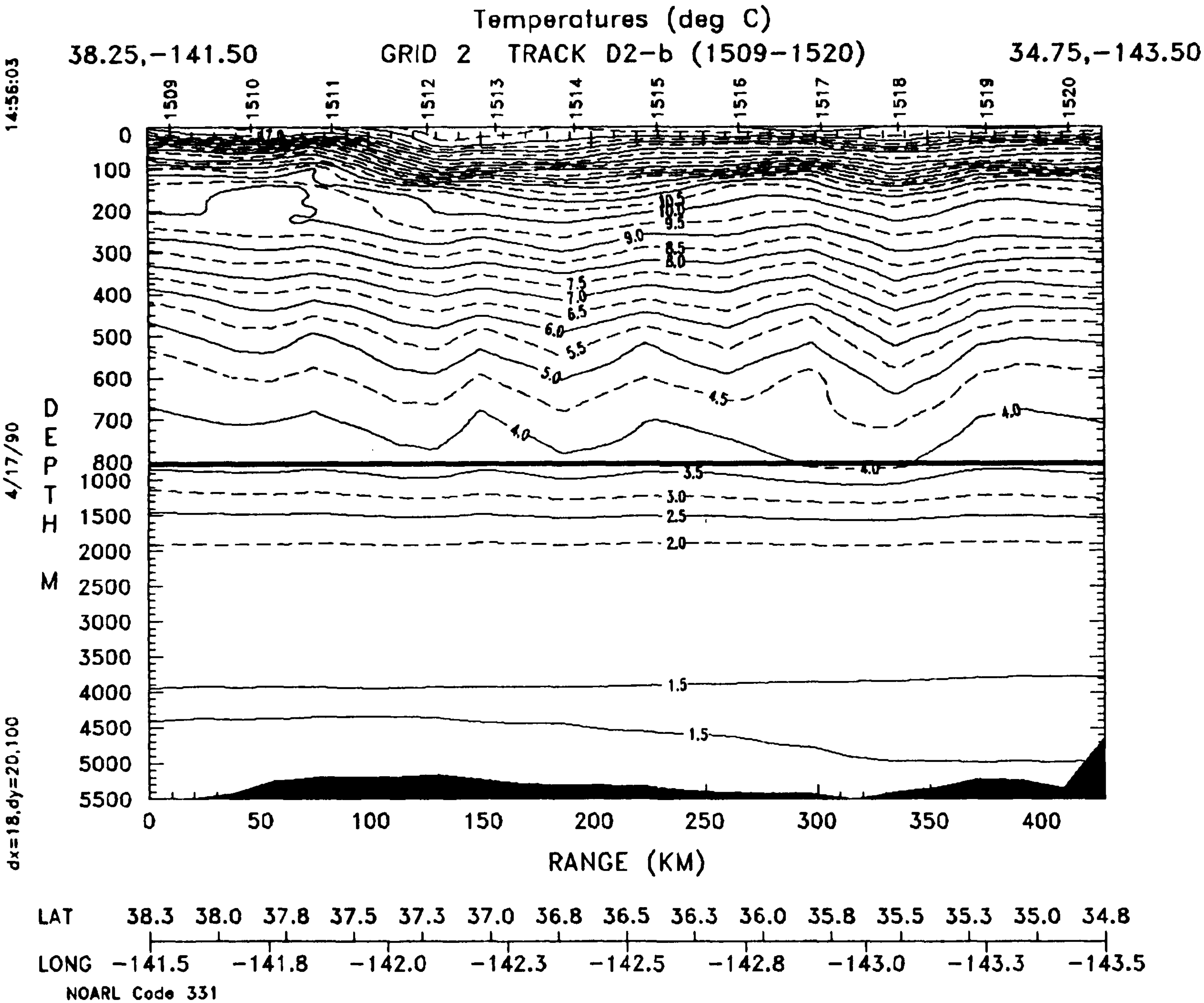
Temperatures (deg C)
39.50,-143.75
GRID 2 TRACK C-a (1406-1414)
35.75,-146.00
1414 1413 1412 1411 1410 1409 1408 1407 1406
12.0
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.0
2.5
2.0
1.5
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8
LONG -143.8 -144.0 -144.3 -144.5 -144.8 -145.0 -145.3 -145.5 -145.8 -146.0
NOARL Code 331
14:50:03
4/17/90
dx=19,dy=20,100



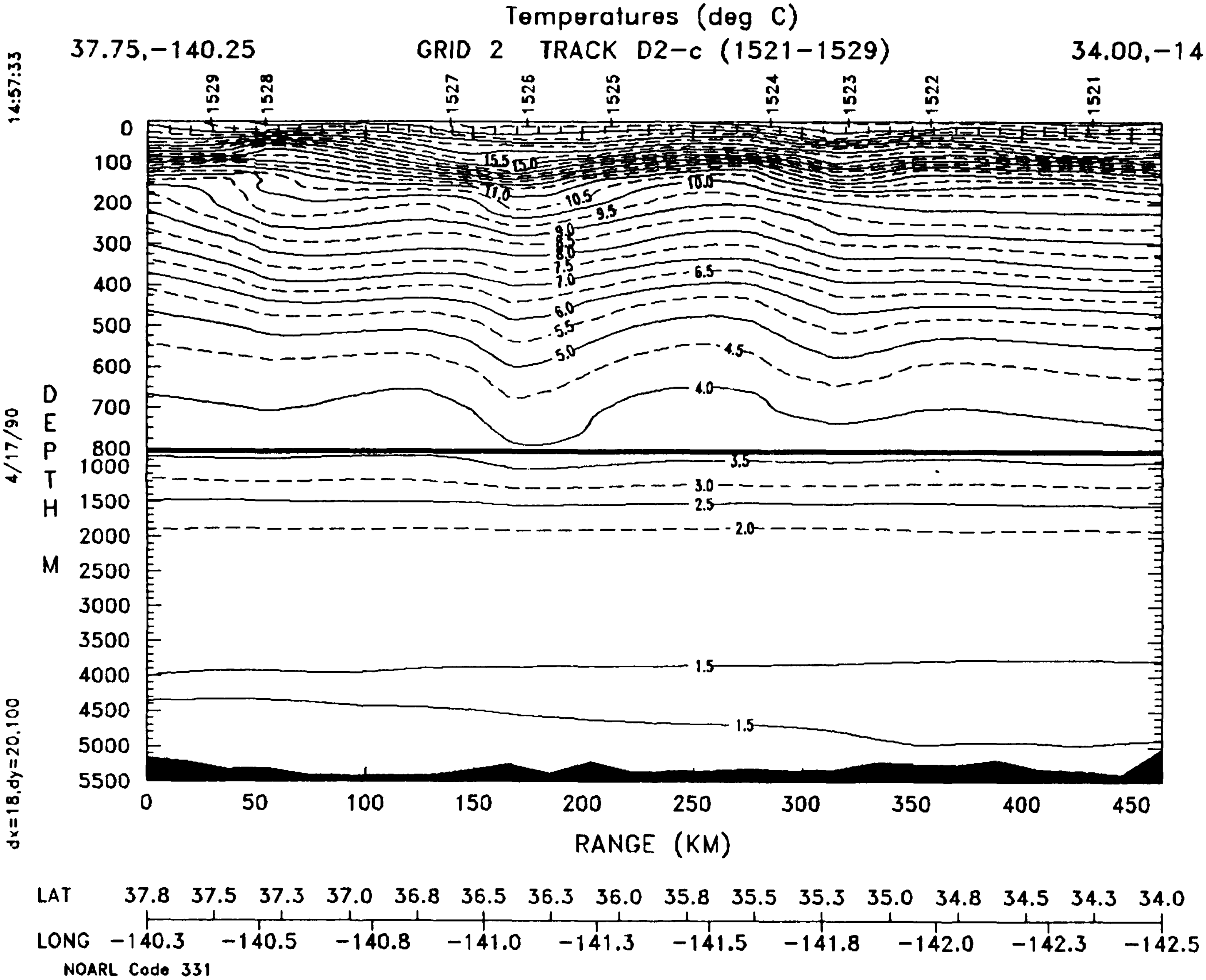
Temperatures (deg C)
39.00,-142.50
GRID 2 TRACK C-c (1426-1436)
35.25,-144.75
14:53:03
4/17/90
dx=19,dy=20,100
1436
1435
1434
1433
1432
1431
1430
1429
1428
1427
1426
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
10.0
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.5
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT
39.0
38.8
38.5
38.3
38.0
37.8
37.5
37.3
37.0
36.8
36.5
36.3
36.0
35.8
35.5
35.3
LONG
-142.5
-142.8
-143.0
-143.3
-143.5
-143.8
-144.0
-144.3
-144.5
-144.8
NOARL Code 331



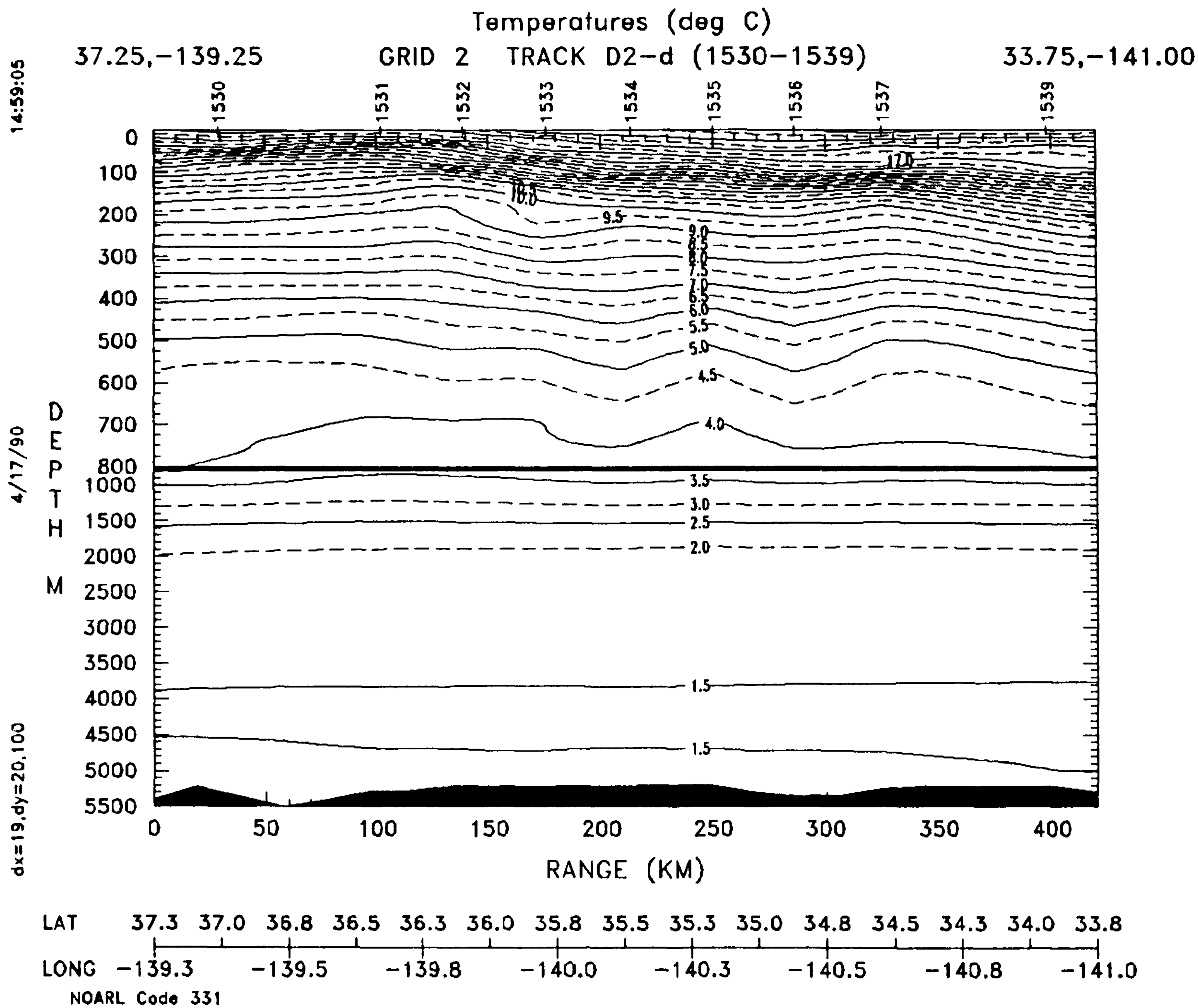
Temperatures (deg C)
38.50,-142.00
GRID 2 TRACK D2-a (1501-1508)
35.00,-144.25
1508
1507
1506
1505
1504
1503
1502
1501
14:54:32
4/17/90
dx=19,dy=20,100
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
0
50
100
150
200
250
300
350
400
RANGE (KM)
LAT 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0
LONG -142.0 -142.3 -142.5 -142.8 -143.0 -143.3 -143.5 -143.8 -144.0 -144.3
NOARL Code 331



Temperatures (deg C)
38.25,-141.50
GRID 2 TRACK D2-b (1509-1520)
34.75,-143.50
1509 1510 1511 1512 1513 1514 1515 1516 1517 1518 1519 1520
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5
0 50 100 150 200 250 300 350 400
RANGE (KM)
LAT 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0 34.8
LONG -141.5 -141.8 -142.0 -142.3 -142.5 -142.8 -143.0 -143.3 -143.5
NOARL Code 331
14:56:03
4/17/90
dx=18,dy=20,100



Temperatures (deg C)
37.75,-140.25
GRID 2 TRACK D2-c (1521-1529)
34.00,-142.50
14:57:33
4/17/90
dx=18,dy=20,100
1529
1528
1527
1526
1525
1524
1523
1522
1521
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
15.5
15.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.5
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT
37.8
37.5
37.3
37.0
36.8
36.5
36.3
36.0
35.8
35.5
35.3
35.0
34.8
34.5
34.3
34.0
LONG
-140.3
-140.5
-140.8
-141.0
-141.3
-141.5
-141.8
-142.0
-142.3
-142.5
NOARL Code 331


Temperatures (deg C)
37.25,-139.25
GRID 2 TRACK D2-d (1530-1539)
33.75,-141.00
1530
1531
1532
1533
1534
1535
1536
1537
1539
14:59:05
4/17/90
dx=19,dy=20,100
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
9.5
9.0
8.5
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.5
0
50
100
150
200
250
300
350
400
RANGE (KM)
LAT 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0 34.8 34.5 34.3 34.0 33.8
LONG -139.3 -139.5 -139.8 -140.0 -140.3 -140.5 -140.8 -141.0
NOARL Code 331

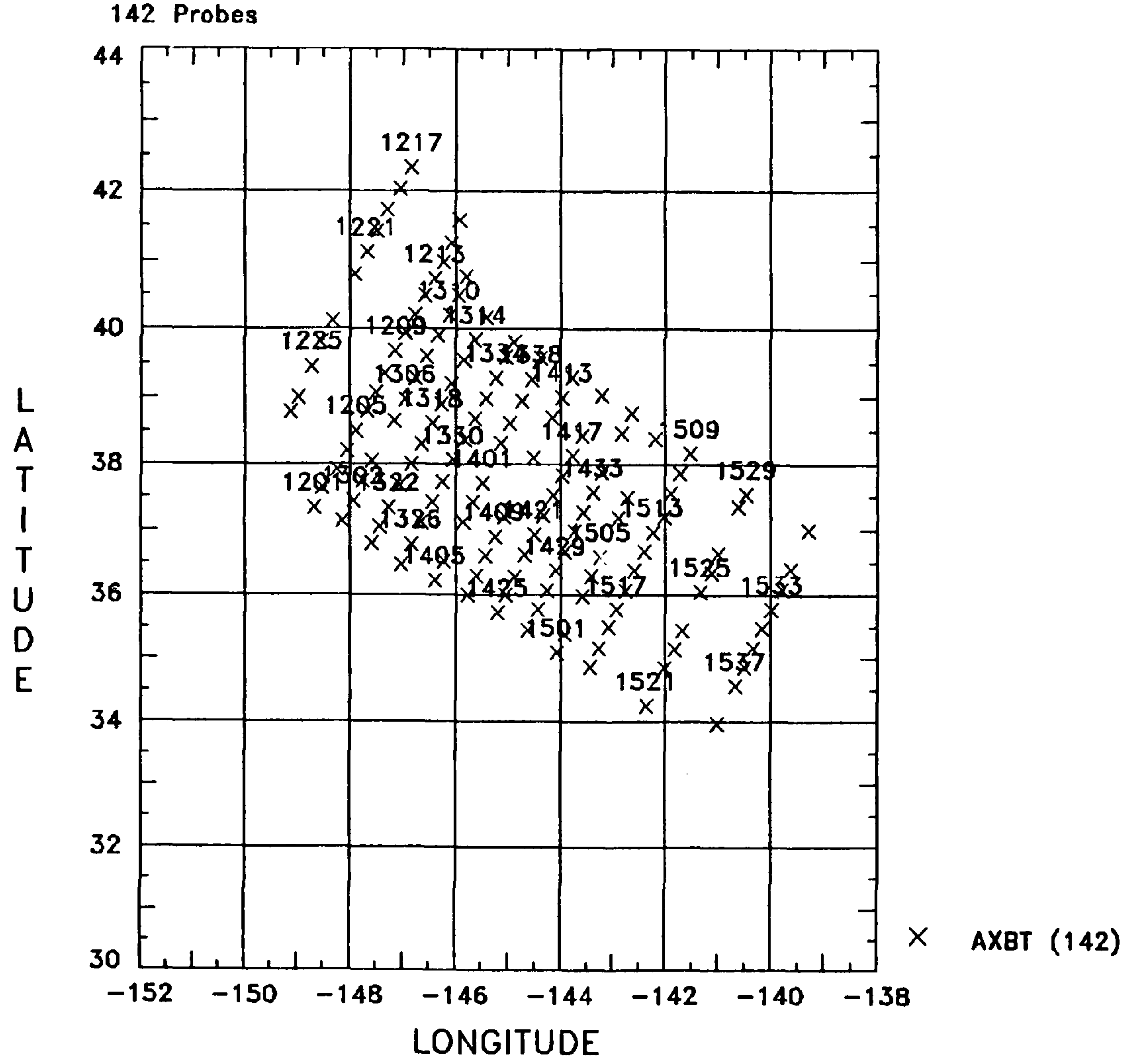
Appendix J.

NEPAC Grid 2 (6 - 7 July 1989)

Inferred Salinity Contours along Selected Vertical Transects

Surface to 5500 m

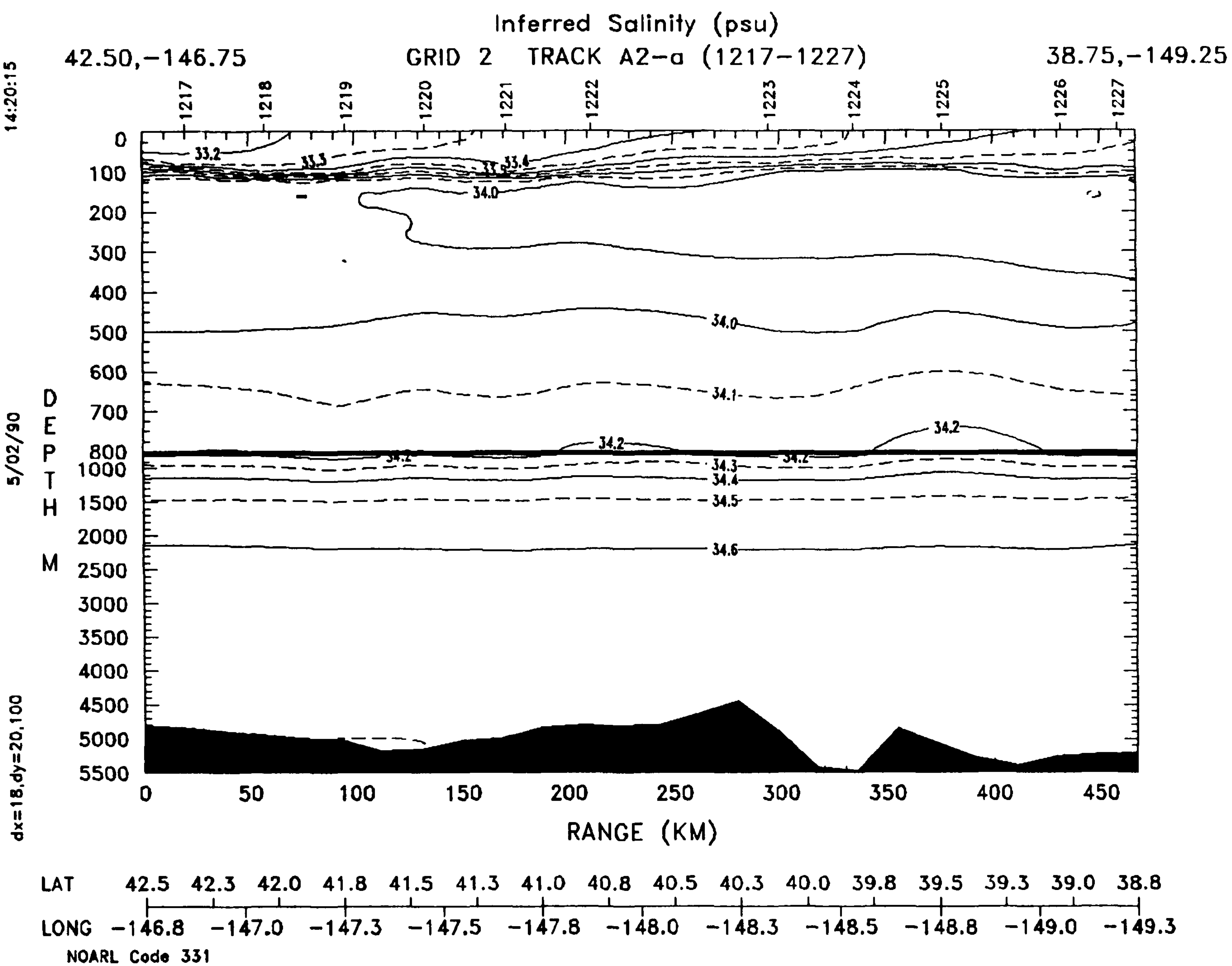
NEPAC Grid 2 (6–7 July 1989)

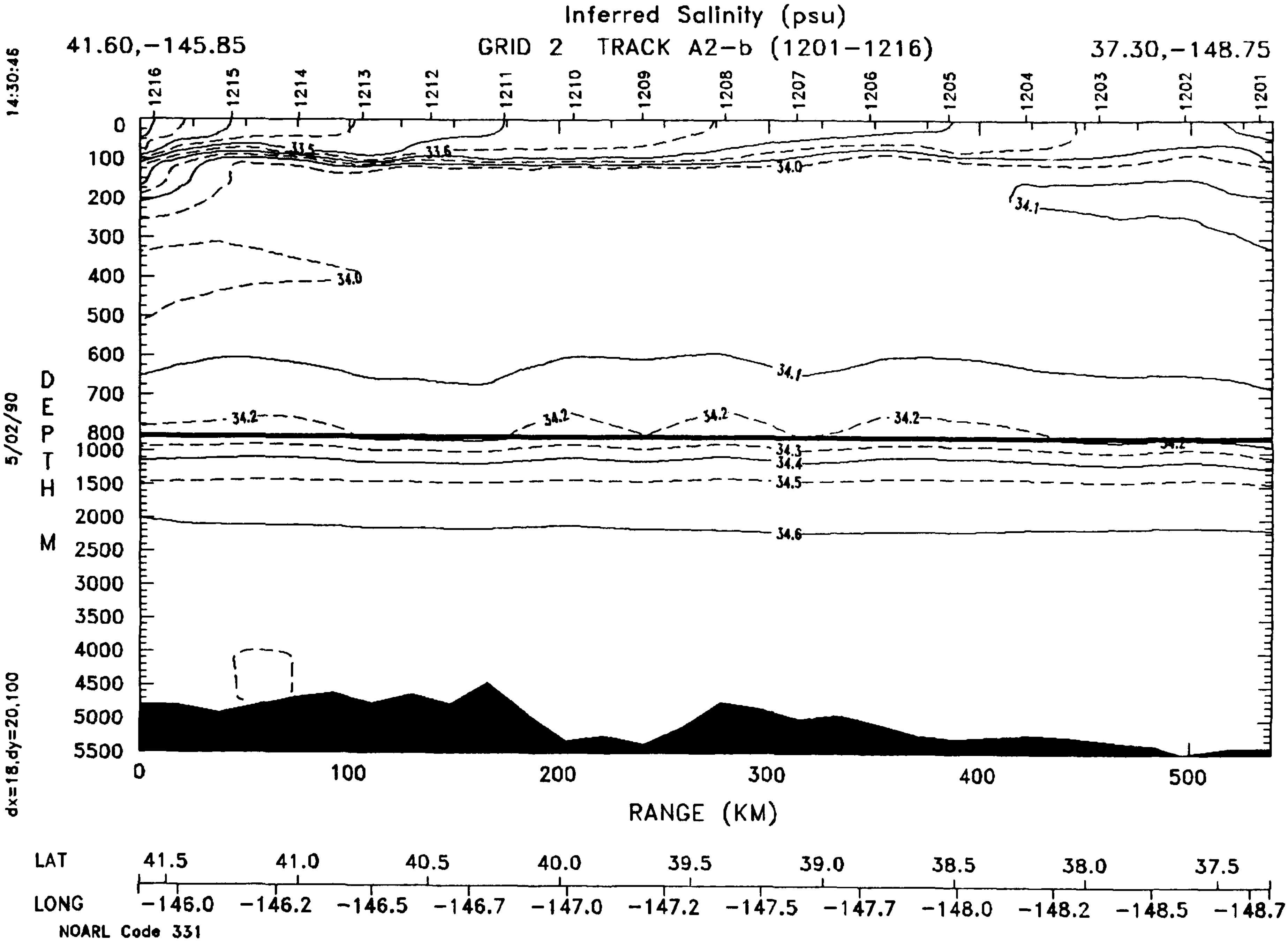


NOARL Code 331

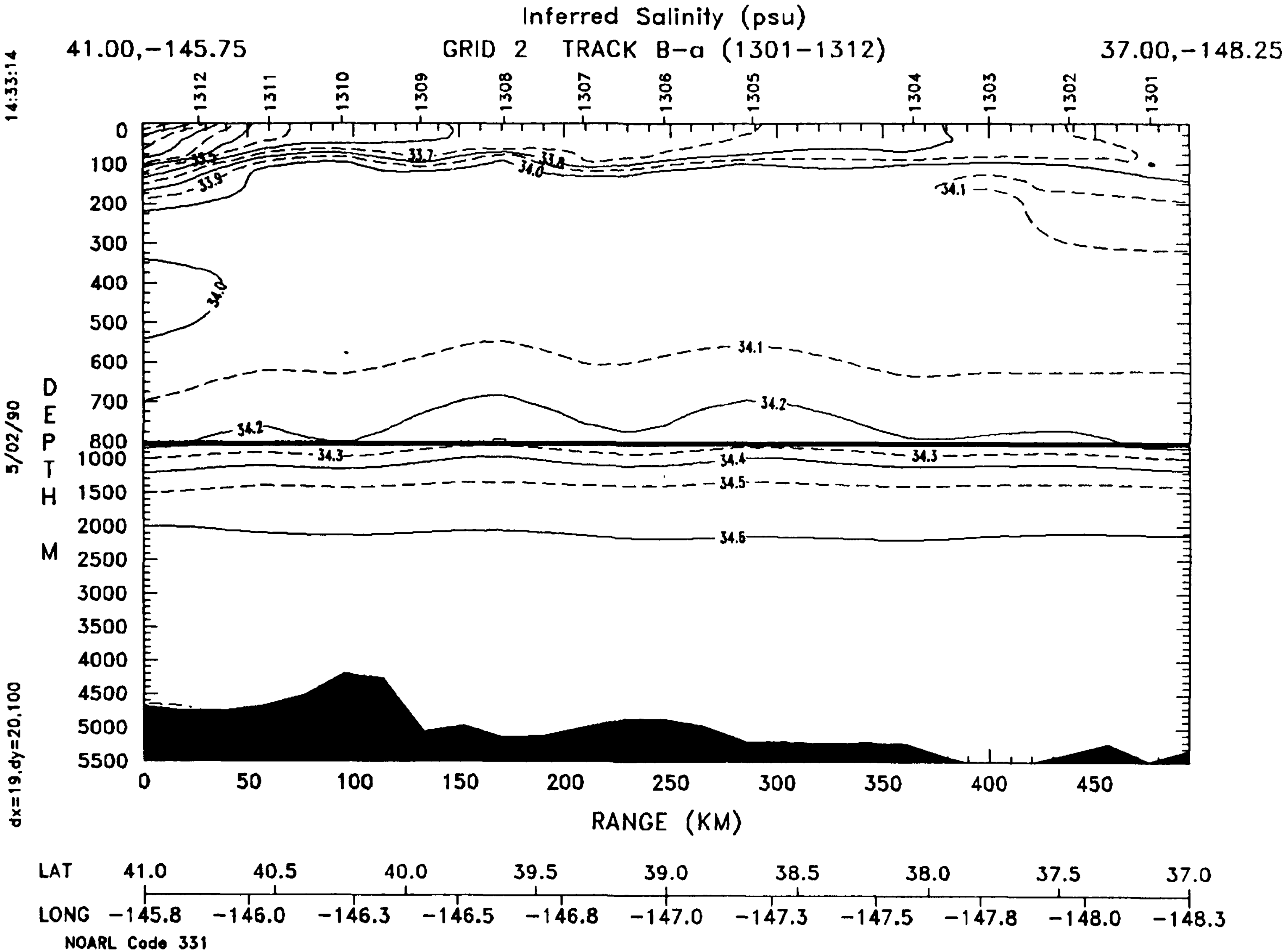
5/09/90

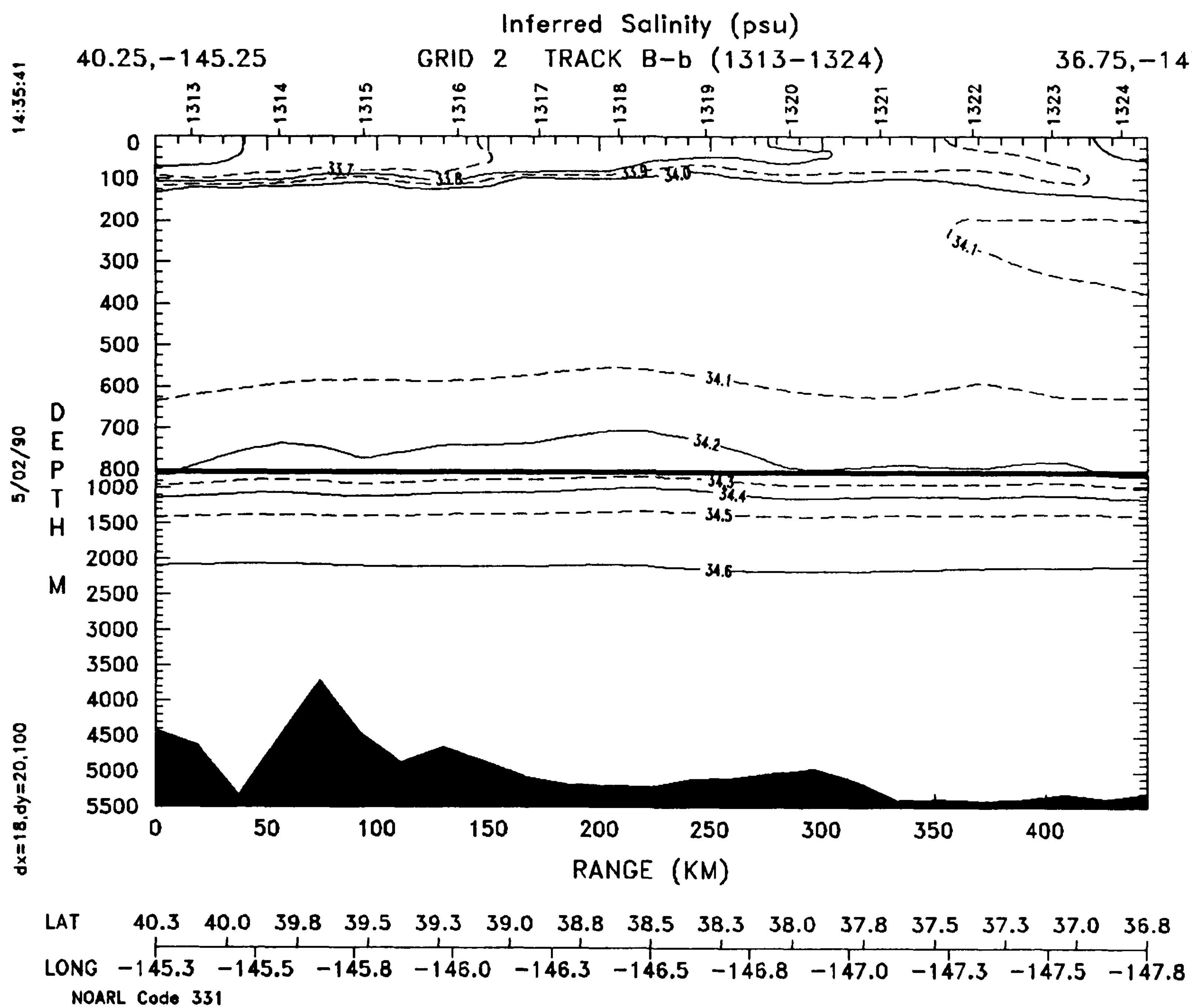
8:55:51

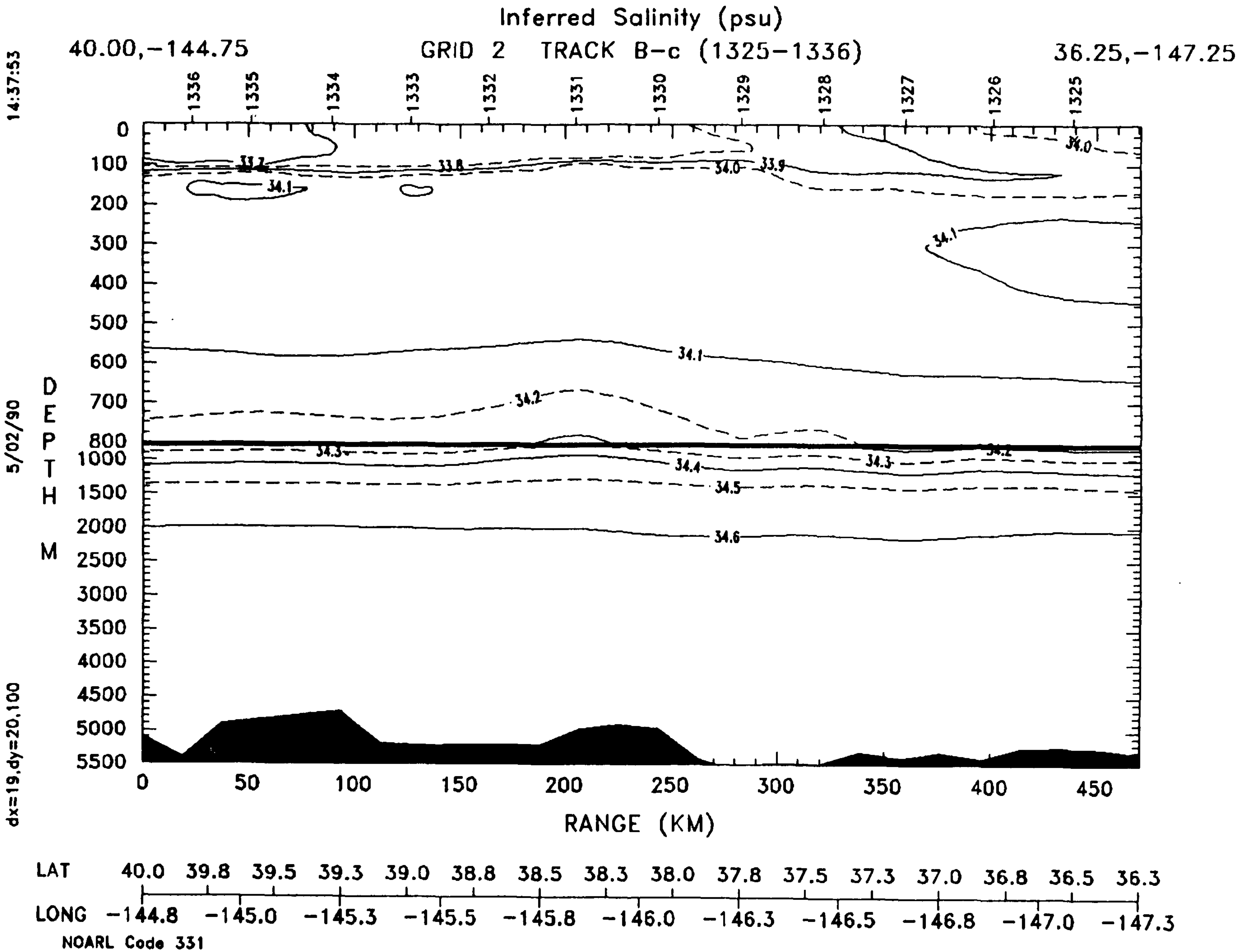

Inferred Salinity (psu)
42.50,-146.75
GRID 2 TRACK A2-a (1217-1227)
38.75,-149.25
14:20:15
5/02/90
dx=18,dy=20,100
1217 1218 1219 1220 1221 1222 1223 1224 1225 1226 1227
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
33.2 33.3 33.4 34.0 34.1 34.2 34.3 34.4 34.5 34.6
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 42.5 42.3 42.0 41.8 41.5 41.3 41.0 40.8 40.5 40.3 40.0 39.8 39.5 39.3 39.0 38.8
LONG -146.8 -147.0 -147.3 -147.5 -147.8 -148.0 -148.3 -148.5 -148.8 -149.0 -149.3
NOARL Code 331

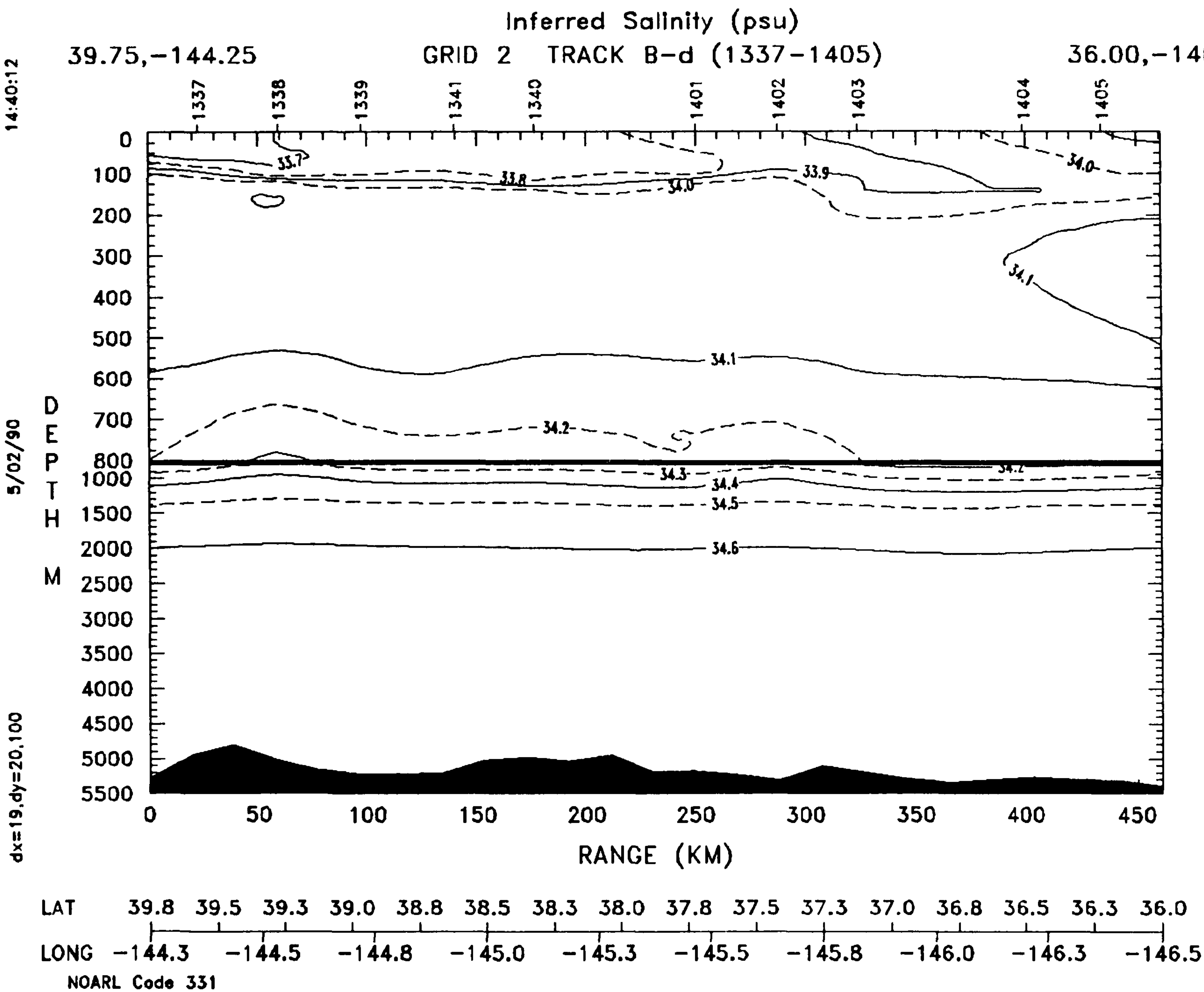


Inferred Salinity (psu)
GRID 2 TRACK A2-b (1201-1216)
41.60,-145.85
37.30,-148.75
14:30:46
5/02/90
dx=18,dy=20,100
1216 1215 1214 1213 1212 1211 1210 1209 1208 1207 1206 1205 1204 1203 1202 1201
33.5
33.6
34.0
34.1
34.2
34.3
34.4
34.5
34.6
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
0 100 200 300 400 500
RANGE (KM)
LAT 41.5 41.0 40.5 40.0 39.5 39.0 38.5 38.0 37.5
LONG -146.0 -146.2 -146.5 -146.7 -147.0 -147.2 -147.5 -147.7 -148.0 -148.2 -148.5 -148.7
NOARL Code 331

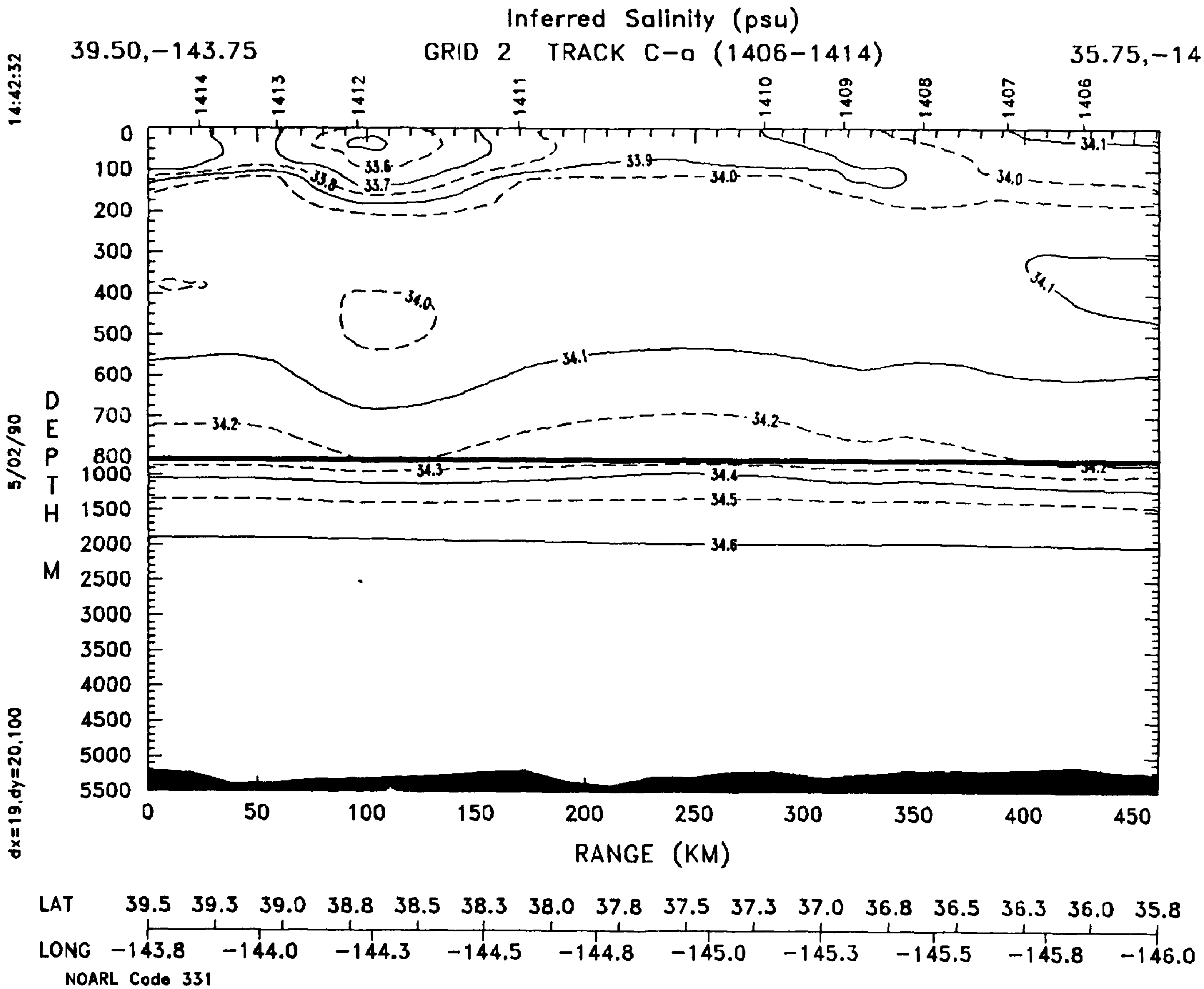

Inferred Salinity (psu)
41.00,-145.75
GRID 2 TRACK B-a (1301-1312)
37.00,-148.25
14:33:14
5/02/90
dx=19,dy=20,100
1312
1311
1310
1309
1308
1307
1306
1305
1304
1303
1302
1301
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT
41.0
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
LONG
-145.8
-146.0
-146.3
-146.5
-146.8
-147.0
-147.3
-147.5
-147.8
-148.0
-148.3
NOARL Code 331


Inferred Salinity (psu)
40.25,-145.25
GRID 2 TRACK B-b (1313-1324)
36.75,-147.75
14:35:41
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
DEPTH M
5/02/90
dx=18,dy=20,100
0 50 100 150 200 250 300 350 400
RANGE (KM)
LAT 40.3 40.0 39.8 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8
LONG -145.3 -145.5 -145.8 -146.0 -146.3 -146.5 -146.8 -147.0 -147.3 -147.5 -147.8
NOARL Code 331

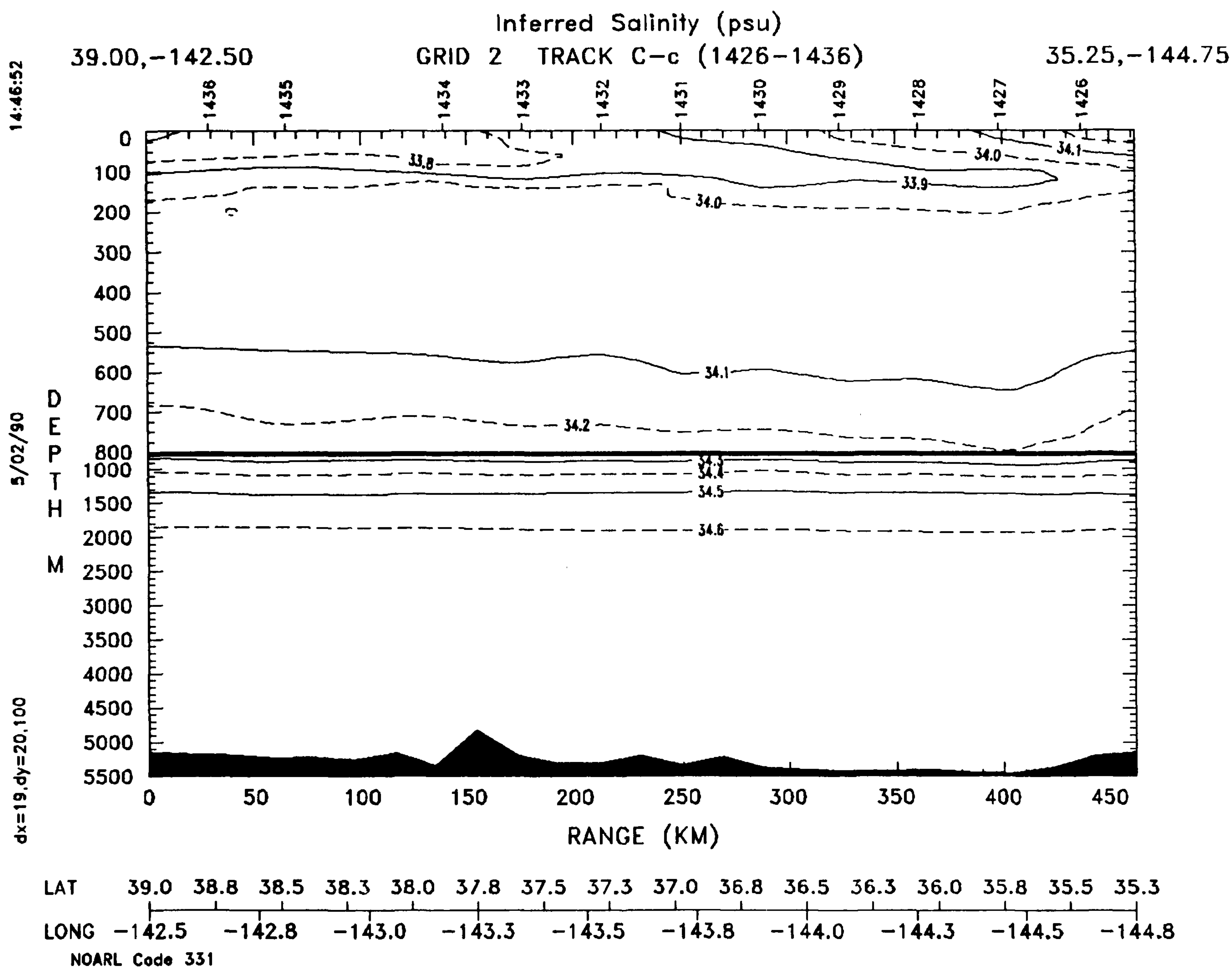

Inferred Salinity (psu)
40.00,-144.75
GRID 2 TRACK B-c (1325-1336)
36.25,-147.25
14:37:53
5/02/90
dx=19,dy=20,100
1336 1335 1334 1333 1332 1331 1330 1329 1328 1327 1326 1325
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
33.7 33.8 33.9 34.0 34.1 34.2 34.3 34.4 34.5 34.6
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 40.0 39.8 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3
LONG -144.8 -145.0 -145.3 -145.5 -145.8 -146.0 -146.3 -146.5 -146.8 -147.0 -147.3
NOARL Code 331

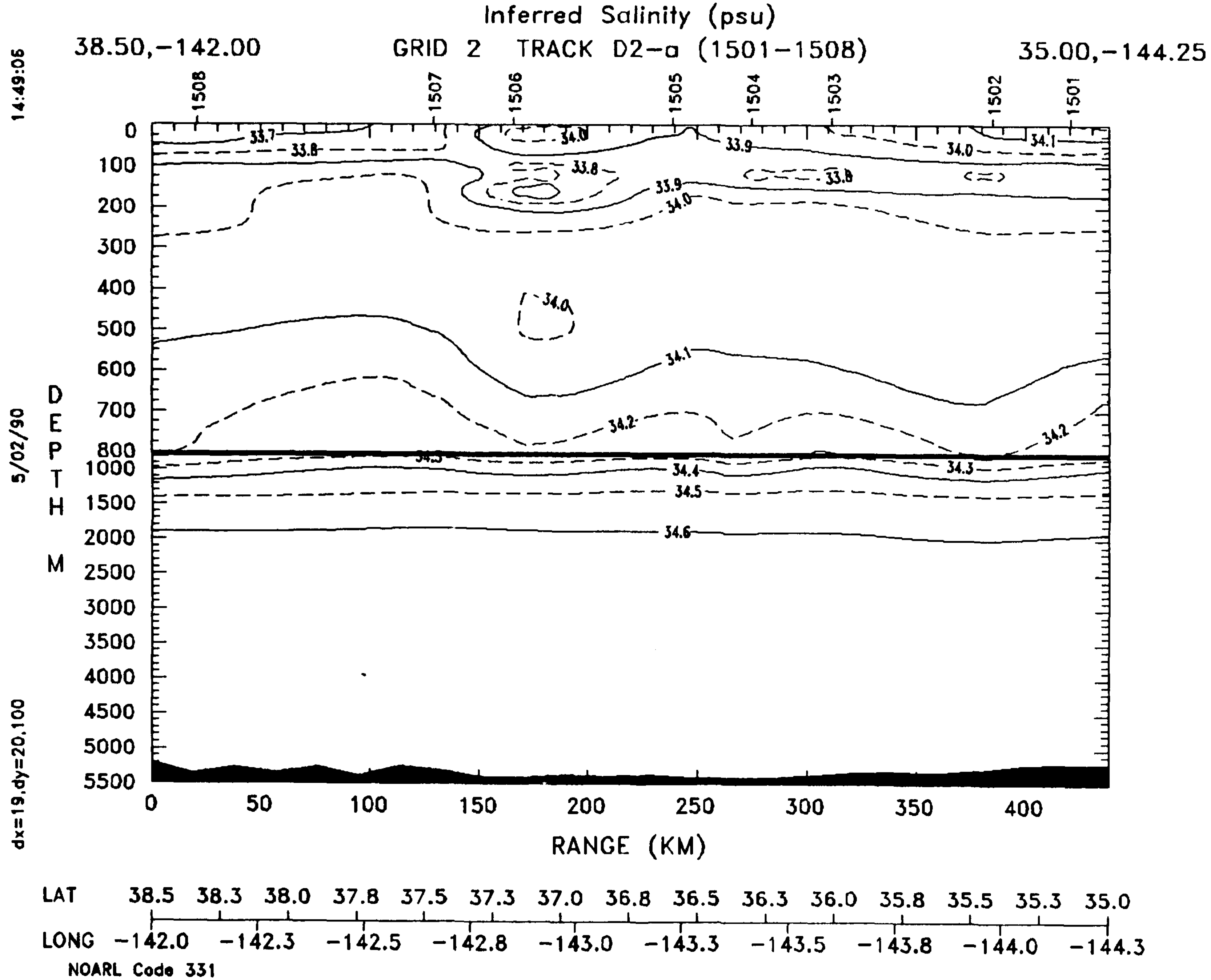


Inferred Salinity (psu)
39.75,-144.25
GRID 2 TRACK B-d (1337-1405)
36.00,-146.50
14:40:12
5/02/90
dx=19,dy=20,100
1337
1338
1339
1341
1340
1401
1402
1403
1404
1405
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT 39.8 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0
LONG −144.3 −144.5 −144.8 −145.0 −145.3 −145.5 −145.8 −146.0 −146.3 −146.5
NOARL Code 331

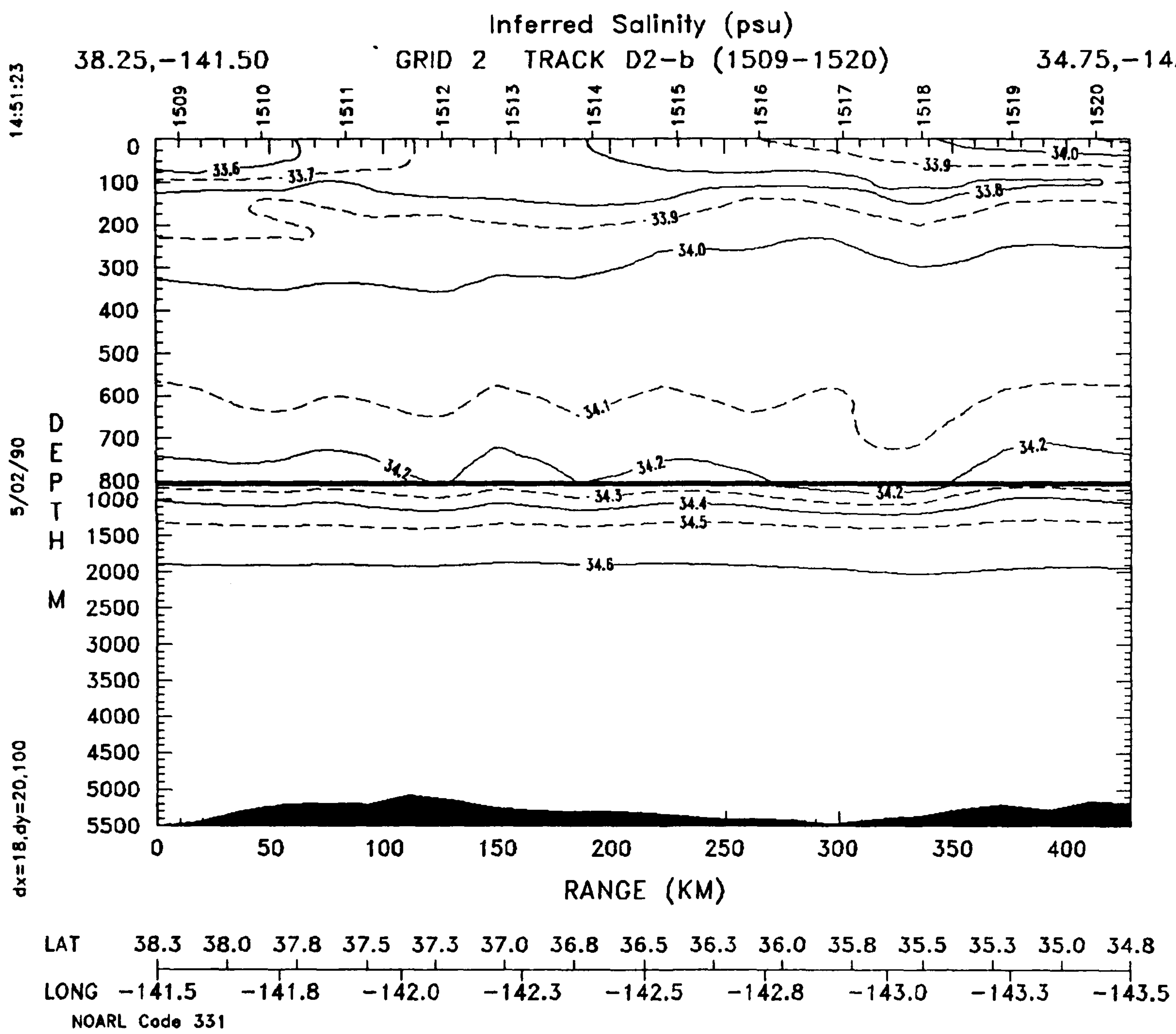


14:42:32
5/02/90
dx=19,dy=20,100
Inferred Salinity (psu)
39.50,-143.75
GRID 2 TRACK C-a (1406-1414)
35.75,-146.00
1414
1413
1412
1411
1410
1409
1408
1407
1406
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
33.6
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8
LONG -143.8 -144.0 -144.3 -144.5 -144.8 -145.0 -145.3 -145.5 -145.8 -146.0
NOARL Code 331

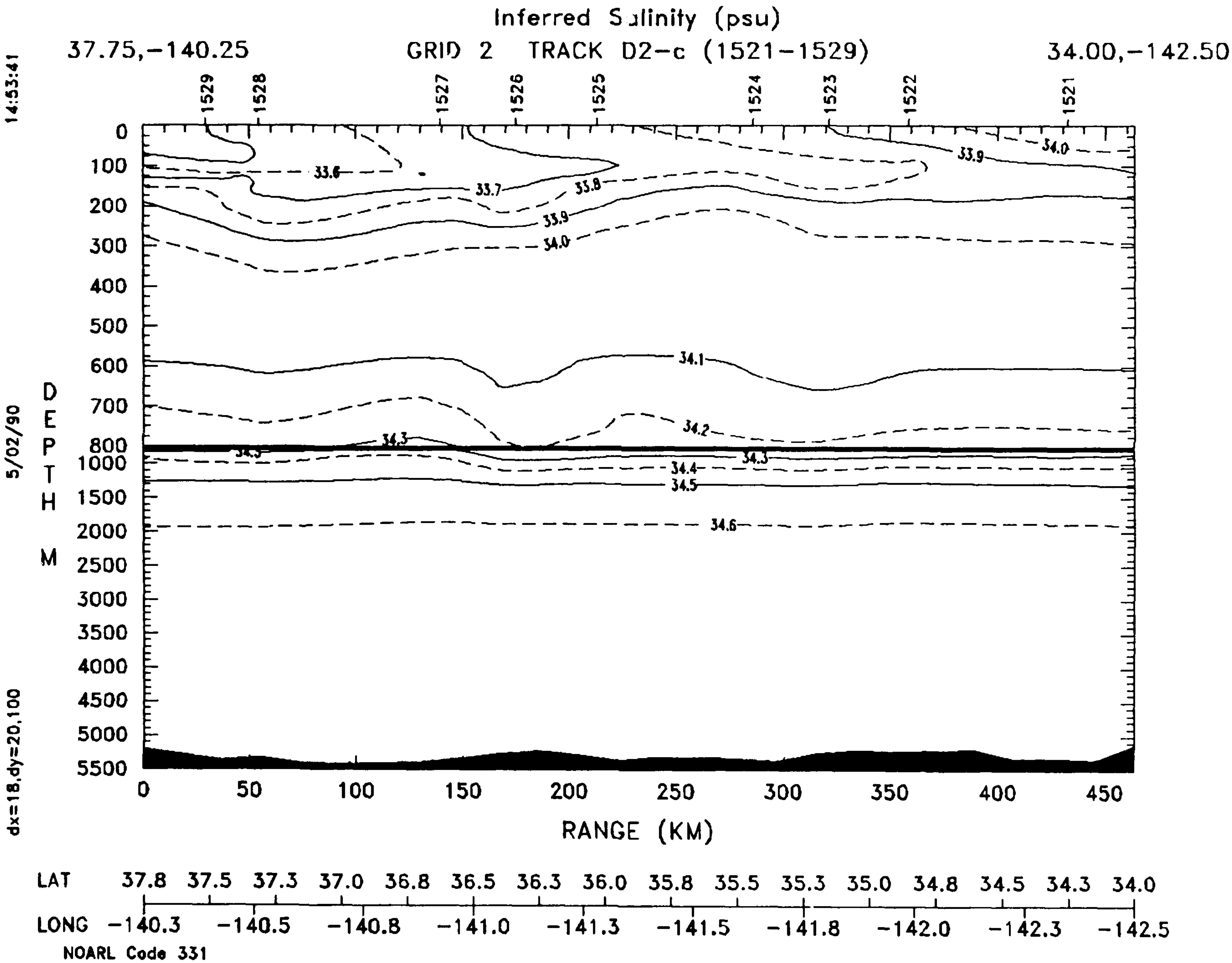

Inferred Salinity (psu)
39.00,-142.50
GRID 2 TRACK C-c (1426-1436)
35.25,-144.75
14:46:52
5/02/90
dx=19,dy=20,100
1436
1435
1434
1433
1432
1431
1430
1429
1428
1427
1426
33.8
33.9
34.0
34.1
34.2
34.5
34.6
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3
LONG -142.5 -142.8 -143.0 -143.3 -143.5 -143.8 -144.0 -144.3 -144.5 -144.8
NOARL Code 331

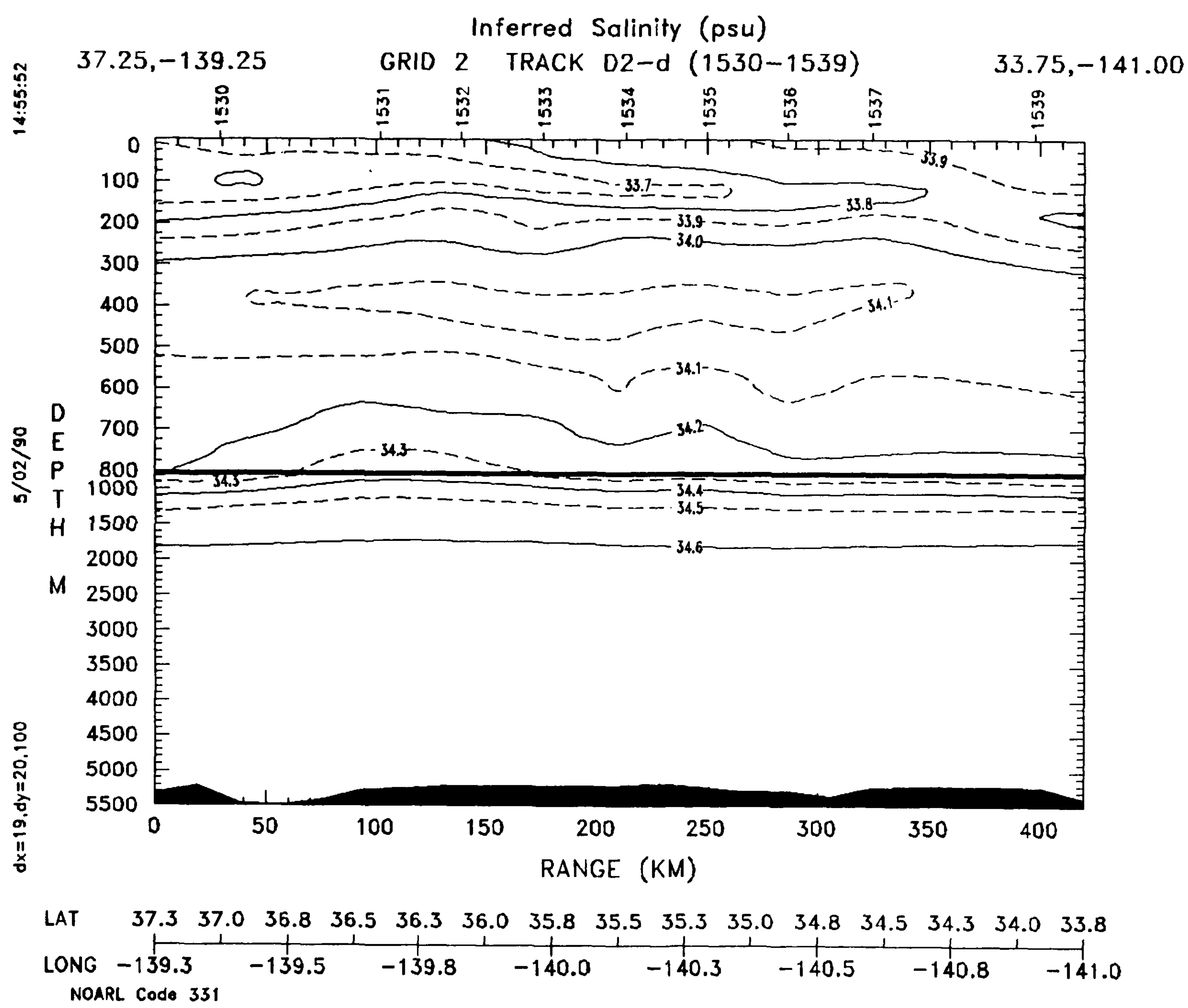


14:49:06
5/02/90
dx=19,dy=20,100
Inferred Salinity (psu)
38.50,-142.00
GRID 2 TRACK D2-a (1501-1508)
35.00,-144.25
1508
1507
1506
1505
1504
1503
1502
1501
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
0 50 100 150 200 250 300 350 400
RANGE (KM)
LAT 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0
LONG -142.0 -142.3 -142.5 -142.8 -143.0 -143.3 -143.5 -143.8 -144.0 -144.3
NOARL Code 331



Inferred Salinity (psu)
38.25,-141.50
GRID 2 TRACK D2-b (1509-1520)
34.75,-143.50
14:51:23
5/02/90
dx=18,dy=20,100
1509 1510 1511 1512 1513 1514 1515 1516 1517 1518 1519 1520
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
33.6
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
0 50 100 150 200 250 300 350 400
RANGE (KM)
LAT 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0 34.8
LONG -141.5 -141.8 -142.0 -142.3 -142.5 -142.8 -143.0 -143.3 -143.5
NOARL Code 331


Inferred Salinity (psu)
37.75,-140.25
GRID 2 TRACK D2-c (1521-1529)
34.00,-142.50
1529
1528
1527
1526
1525
1524
1523
1522
1521
14:53:41
5/02/90
dx=18,dy=20,100
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
33.6
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0 34.8 34.5 34.3 34.0
LONG -140.3 -140.5 -140.8 -141.0 -141.3 -141.5 -141.8 -142.0 -142.3 -142.5
NOARL Code 331


Inferred Salinity (psu)
37.25,-139.25
GRID 2 TRACK D2-d (1530-1539)
33.75,-141.00
1530
1531
1532
1533
1534
1535
1536
1537
1539
14:55:52
5/02/90
dx=19,dy=20,100
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
0
50
100
150
200
250
300
350
400
RANGE (KM)
LAT 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0 34.8 34.5 34.3 34.0 33.8
LONG -139.3 -139.5 -139.8 -140.0 -140.3 -140.5 -140.8 -141.0
NOARL Code 331

Appendix K

NEPAC Grid 2 (6 - 7 July 1989)

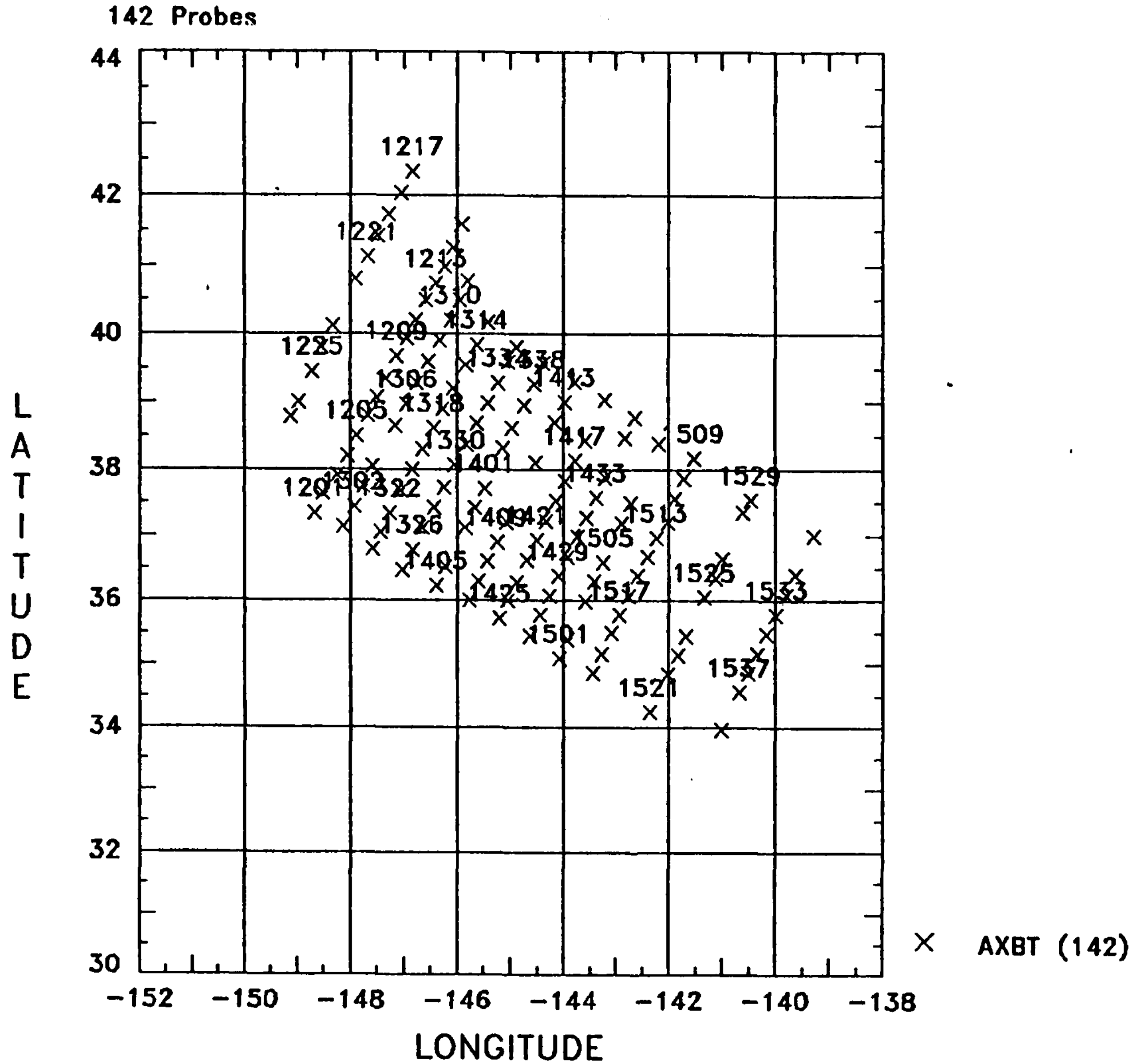
Calculated Sound Speed Contours along Selected Vertical Transects

Surface to 5500 m

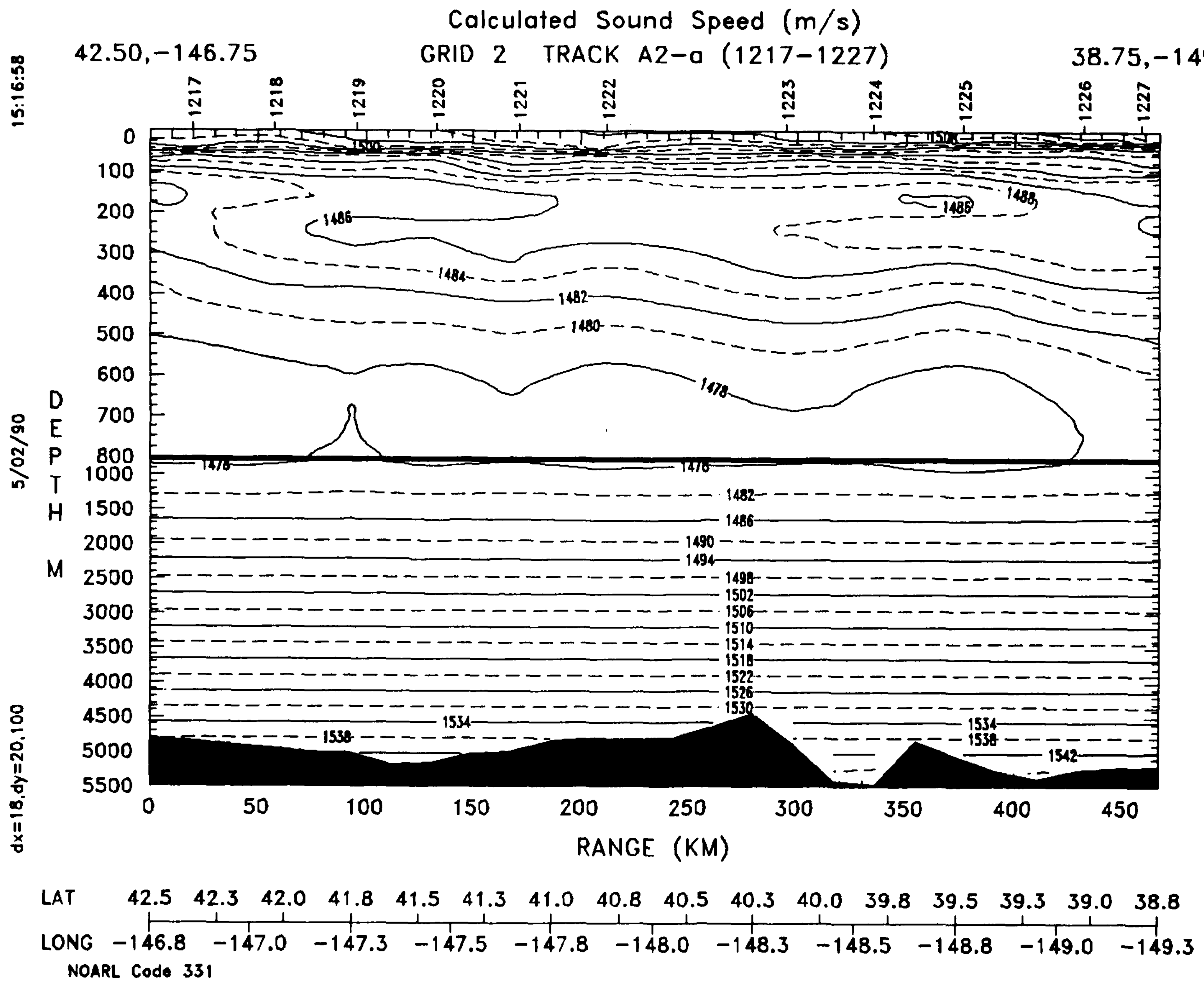
8:55:51

5/09/90

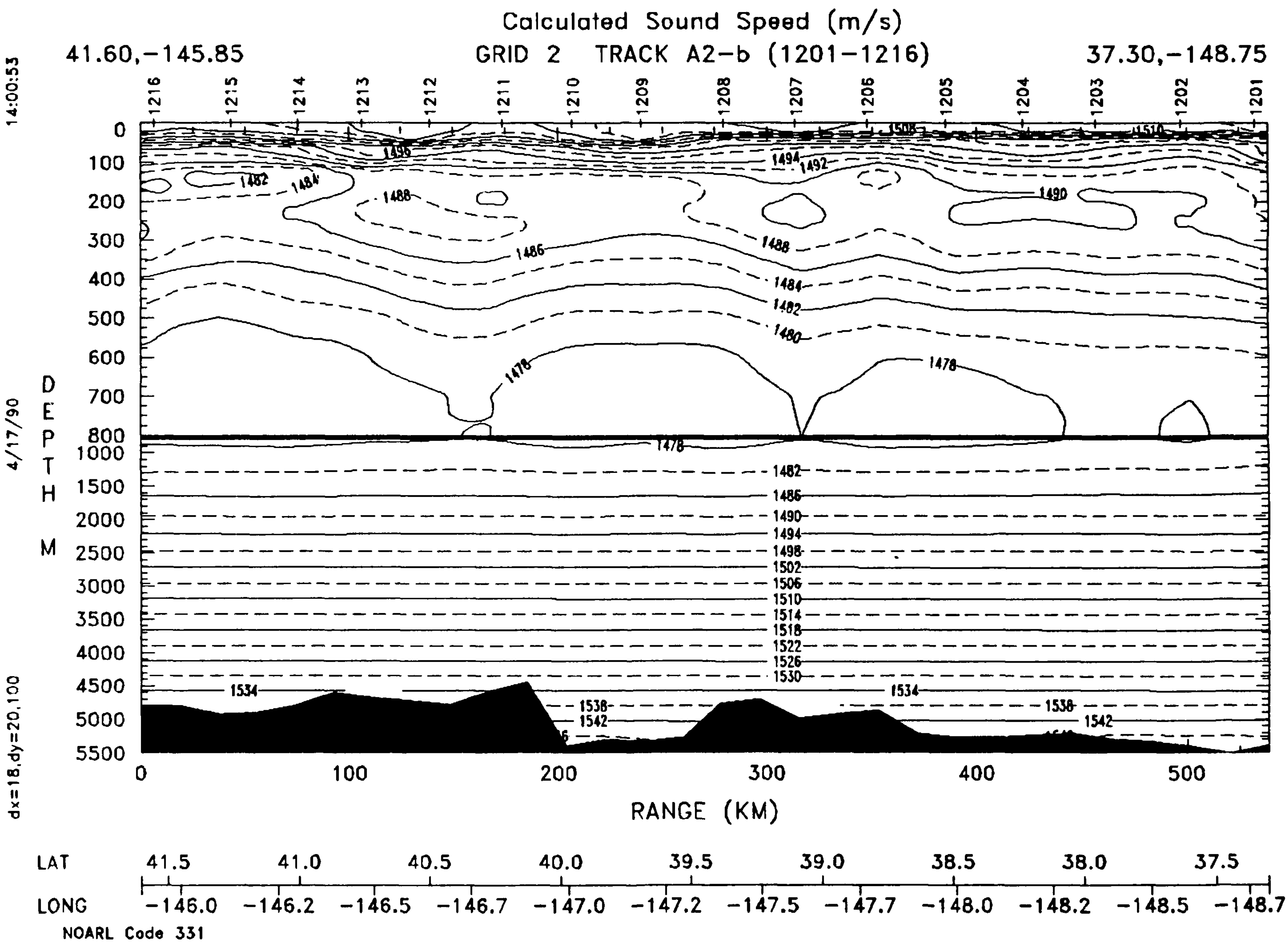
NEPAC Grid 2 (6–7 July 1989)



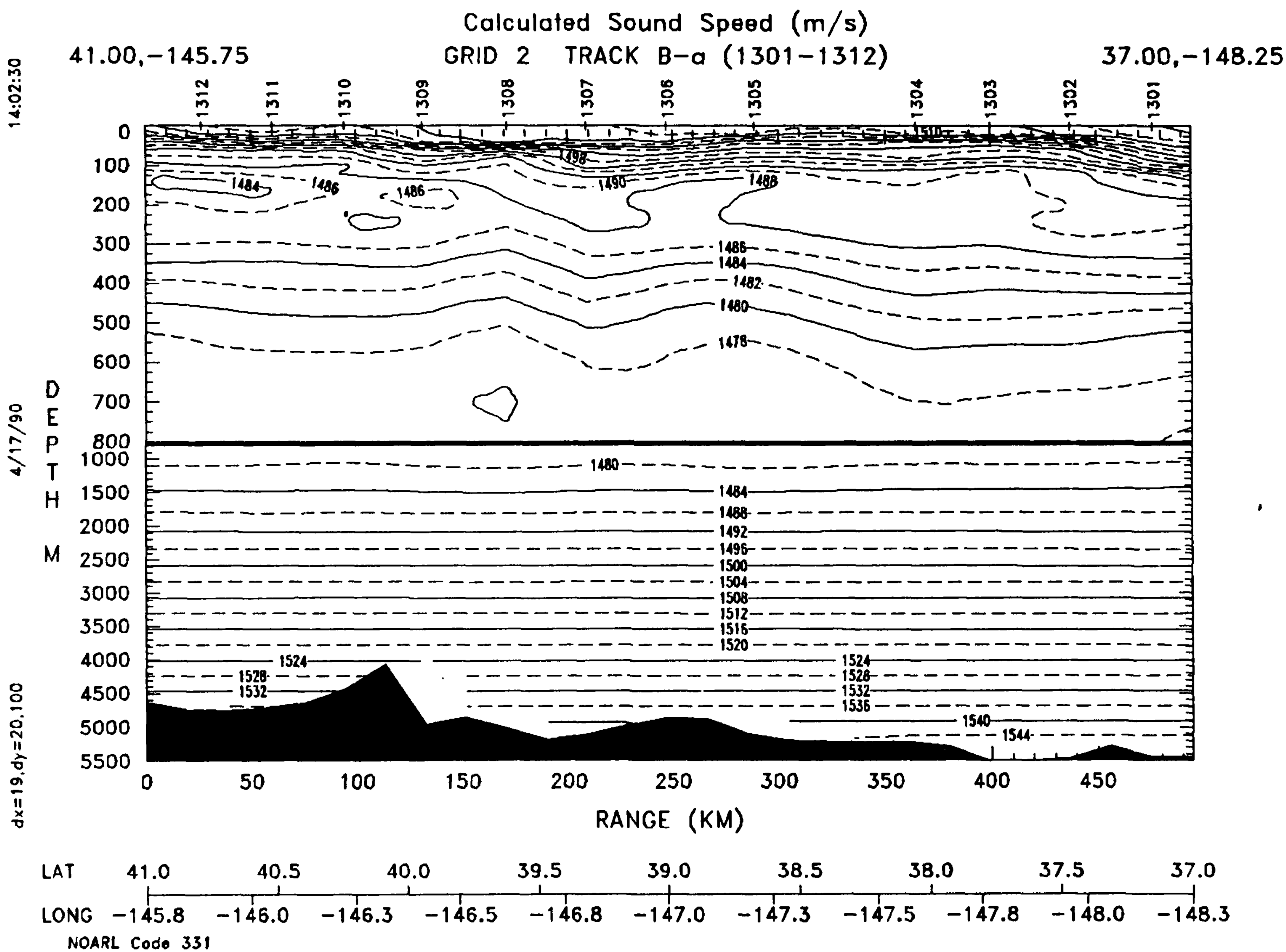
NOARL Code 331



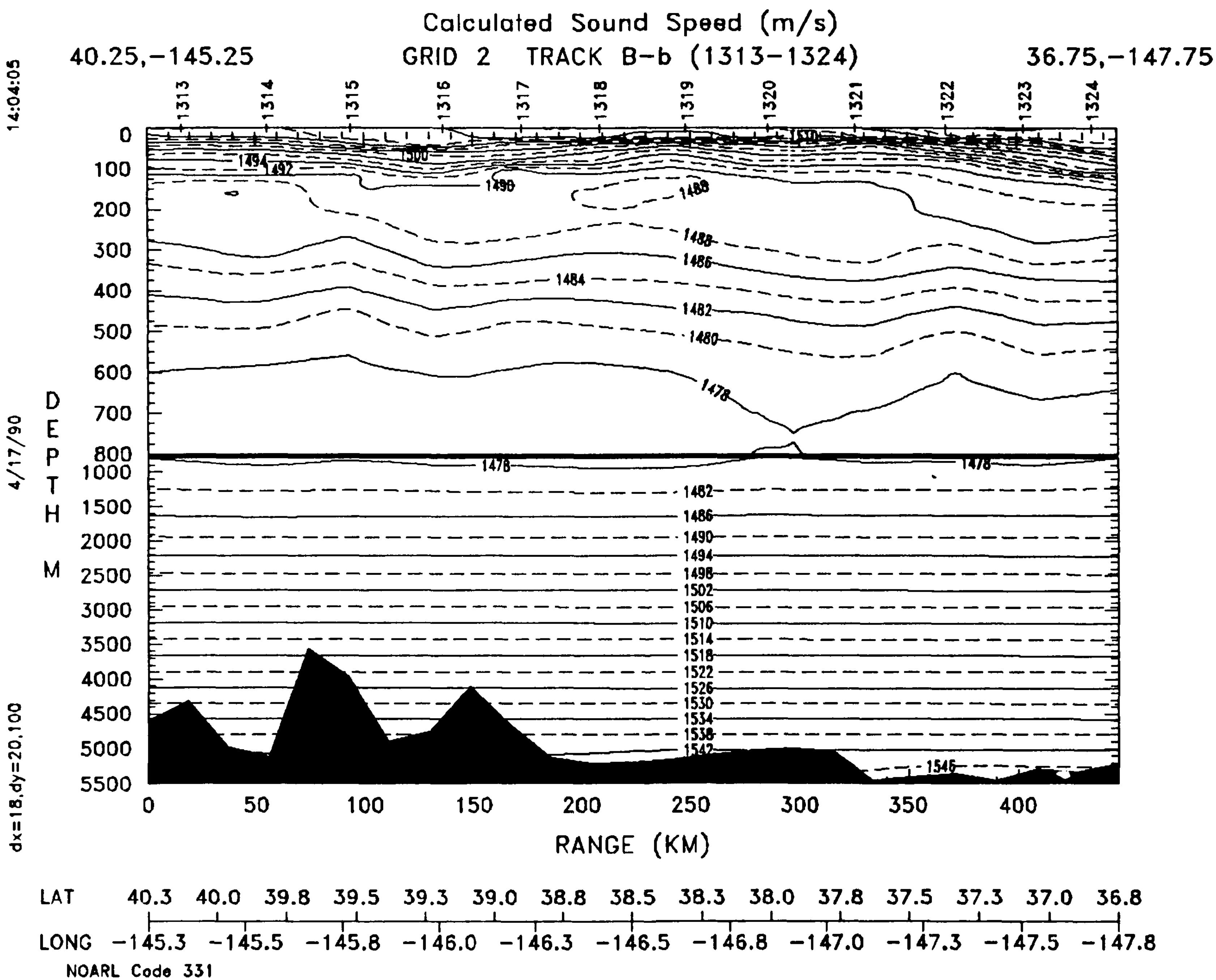
Calculated Sound Speed (m/s)
42.50,-146.75
GRID 2 TRACK A2-a (1217-1227)
38.75,-149.25
15:16:58
5/02/90
dx=18,dy=20,100
1217 1218 1219 1220 1221 1222 1223 1224 1225 1226 1227
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
1486
1488
1484
1482
1480
1478
1490
1494
1498
1502
1506
1510
1514
1518
1522
1526
1530
1534
1538
1542
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 42.5 42.3 42.0 41.8 41.5 41.3 41.0 40.8 40.5 40.3 40.0 39.8 39.5 39.3 39.0 38.8
LONG -146.8 -147.0 -147.3 -147.5 -147.8 -148.0 -148.3 -148.5 -148.8 -149.0 -149.3
NOARL Code 331

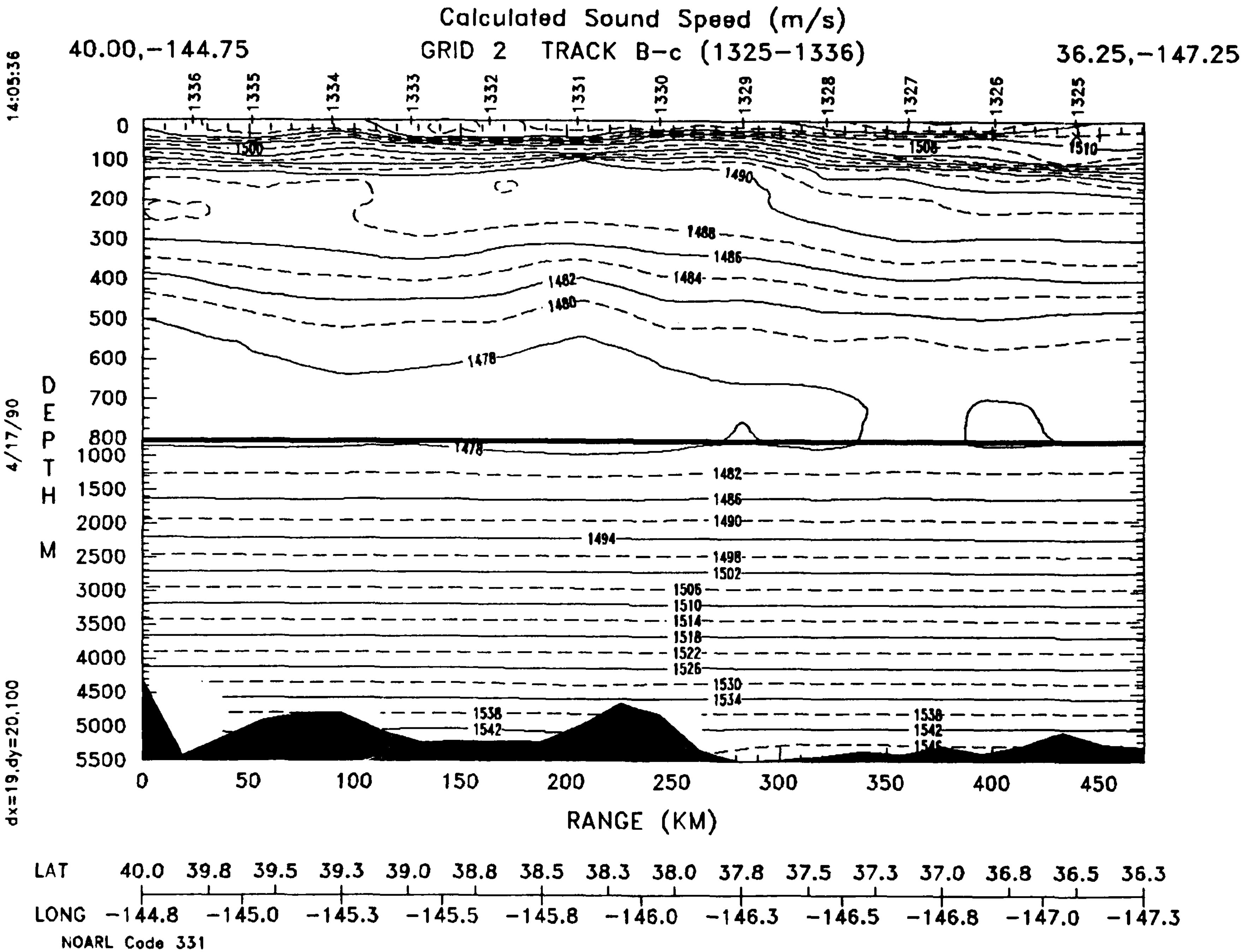


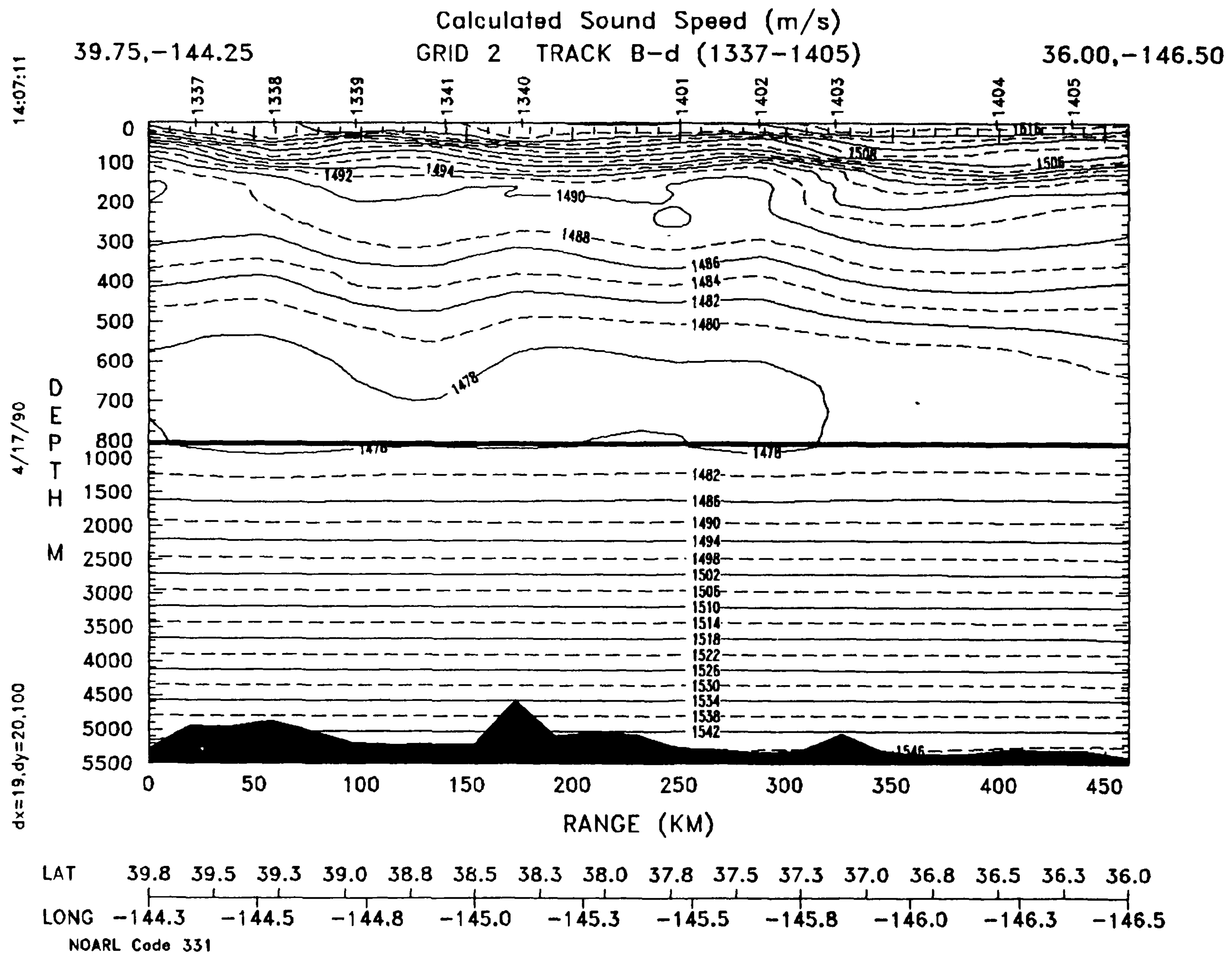
Calculated Sound Speed (m/s)
41.60,-145.85
GRID 2 TRACK A2-b (1201-1216)
37.30,-148.75
14:00:53
4/17/90
dx=18,dy=20,100
1216 1215 1214 1213 1212 1211 1210 1209 1208 1207 1206 1205 1204 1203 1202 1201
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
1478 1480 1482 1484 1486 1488 1490 1492 1494 1496 1498 1502 1506 1508 1510 1514 1518 1522 1526 1530 1534 1538 1542
0 100 200 300 400 500
RANGE (KM)
LAT 41.5 41.0 40.5 40.0 39.5 39.0 38.5 38.0 37.5
LONG -146.0 -146.2 -146.5 -146.7 -147.0 -147.2 -147.5 -147.7 -148.0 -148.2 -148.5 -148.7
NOARL Code 331



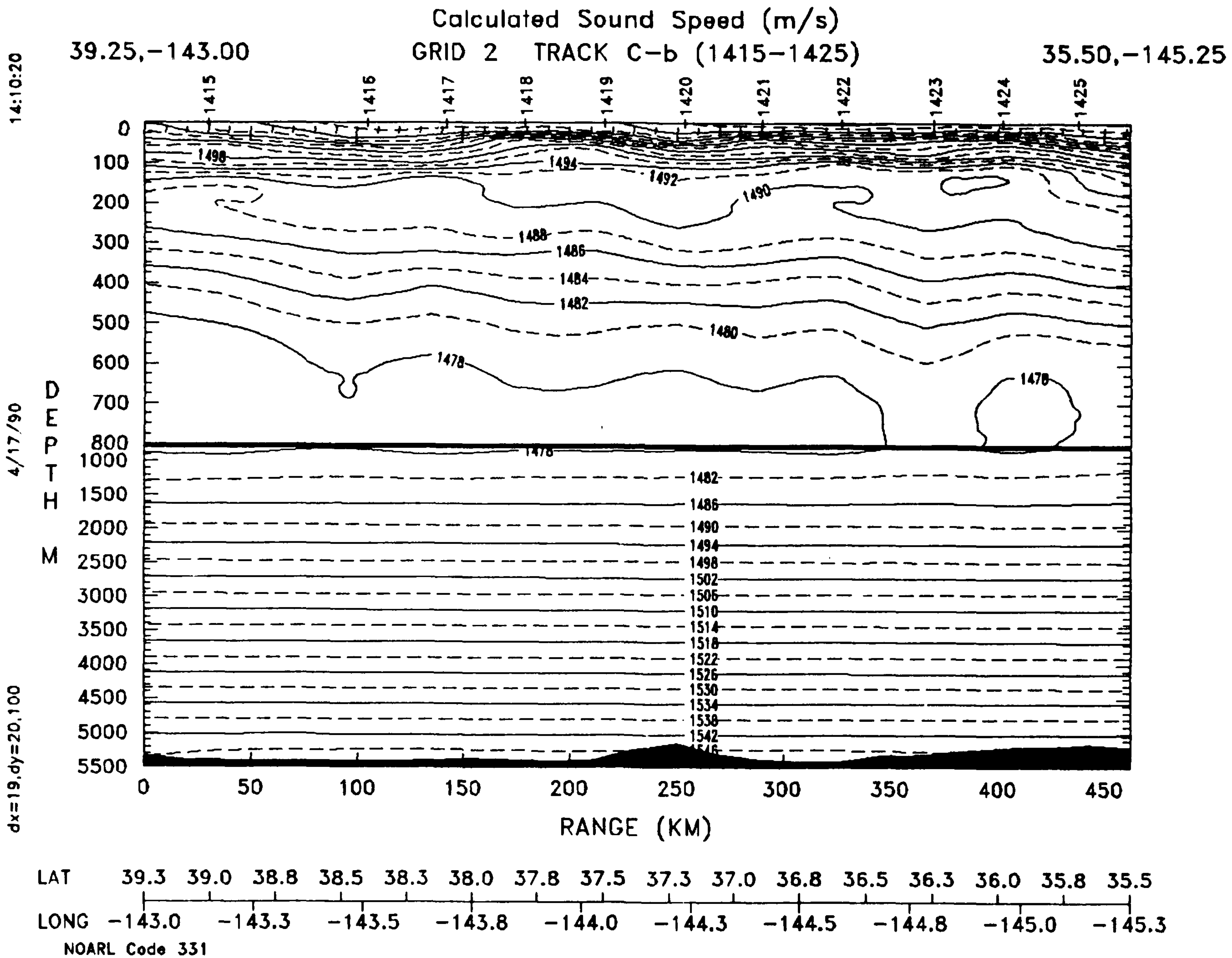
Calculated Sound Speed (m/s)
41.00,-145.75
GRID 2 TRACK B-a (1301-1312)
37.00,-148.25
14:02:30
4/17/90
dx=19,dy=20,100
1312
1311
1310
1309
1308
1307
1306
1305
1304
1303
1302
1301
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
1484
1486
1488
1490
1498
1510
1482
1480
1478
1492
1496
1500
1504
1508
1512
1516
1520
1524
1528
1532
1536
1540
1544
RANGE (KM)
0
50
100
150
200
250
300
350
400
450
LAT
41.0
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
LONG
-145.8
-146.0
-146.3
-146.5
-146.8
-147.0
-147.3
-147.5
-147.8
-148.0
-148.3
NOARL Code 331


Calculated Sound Speed (m/s)
40.25,-145.25
GRID 2 TRACK B-b (1313-1324)
36.75,-147.75
1313
1314
1315
1316
1317
1318
1319
1320
1321
1322
1323
1324
DEPTH M
RANGE (KM)
LAT 40.3 40.0 39.8 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8
LONG -145.3 -145.5 -145.8 -146.0 -146.3 -146.5 -146.8 -147.0 -147.3 -147.5 -147.8
NOARL Code 331
14:04:05
4/17/90
dx=18,dy=20,100

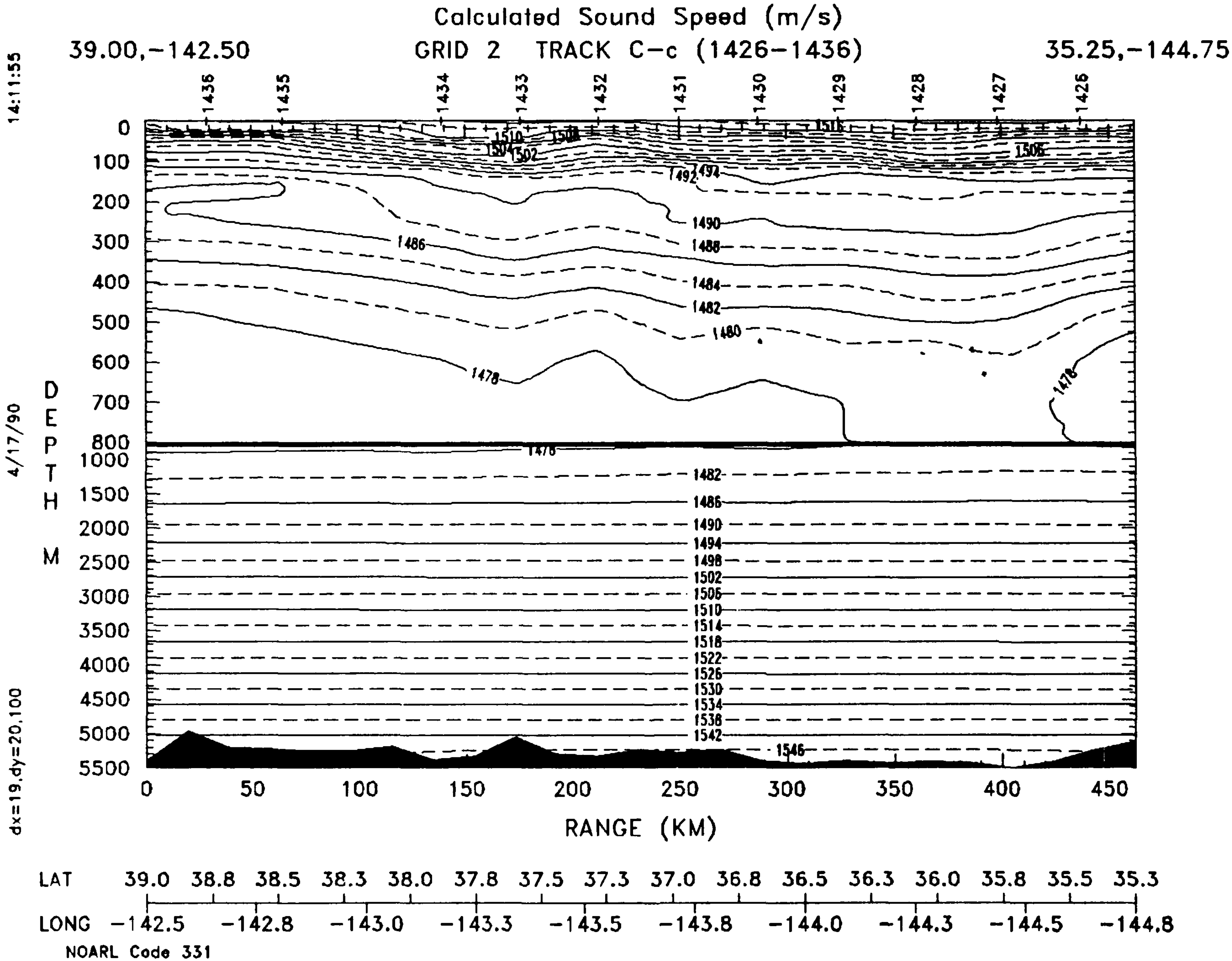

Calculated Sound Speed (m/s)
40.00,-144.75
GRID 2 TRACK B-c (1325-1336)
36.25,-147.25
14:05:36
4/17/90
dx=19,dy=20,100
DEPTH M
RANGE (KM)
LAT 40.0 39.8 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3
LONG -144.8 -145.0 -145.3 -145.5 -145.8 -146.0 -146.3 -146.5 -146.8 -147.0 -147.3
NOARL Code 331



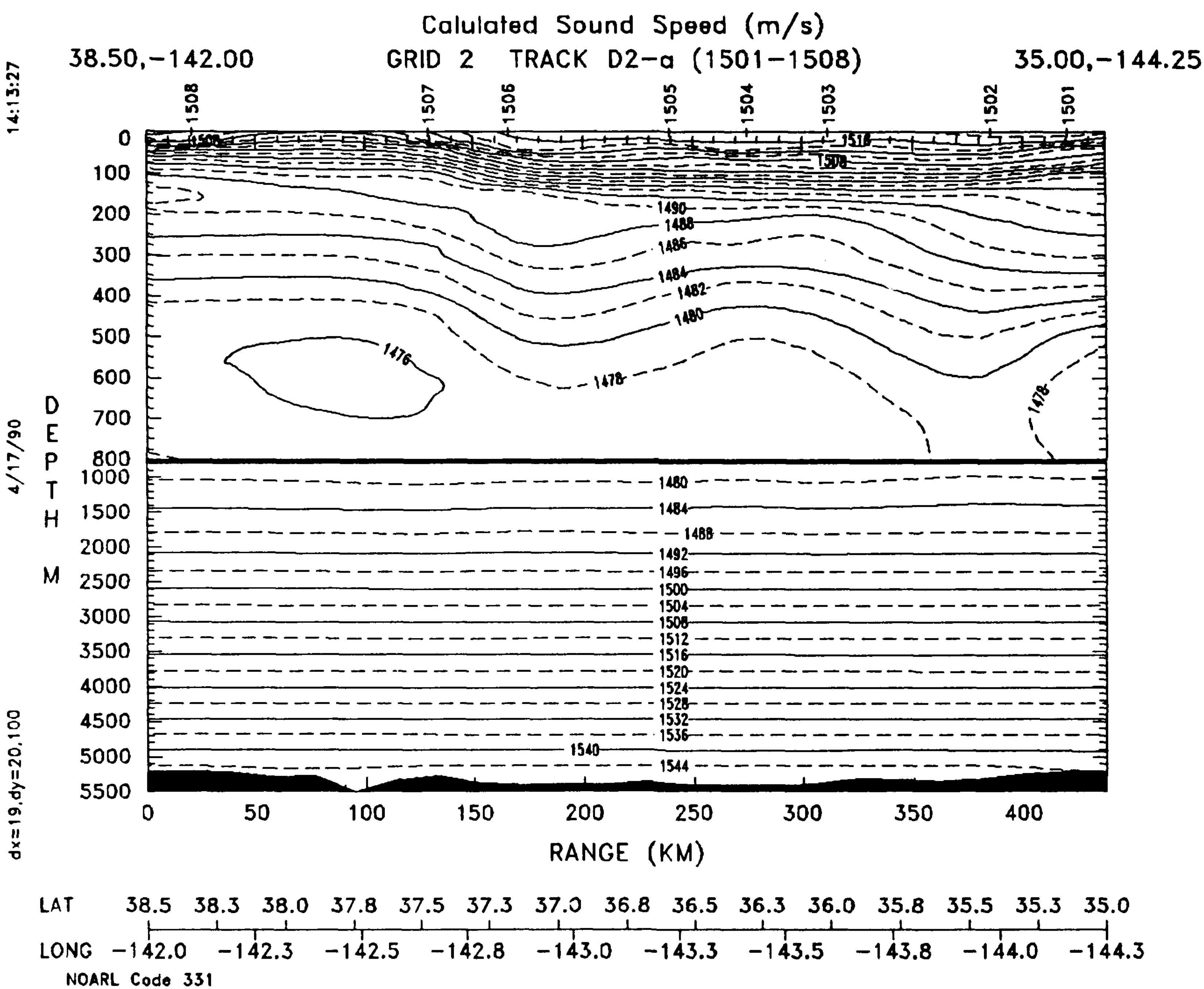
Calculated Sound Speed (m/s)
39.75,-144.25
GRID 2 TRACK B-d (1337-1405)
36.00,-146.50
14:07:11
4/17/90
dx=19,dy=20,100
1337
1338
1339
1341
1340
1401
1402
1403
1404
1405
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
1492
1494
1490
1488
1486
1484
1482
1480
1478
1506
1508
1482
1486
1490
1494
1498
1502
1506
1510
1514
1518
1522
1526
1530
1534
1538
1542
1546
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT 39.8 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0
LONG -144.3 -144.5 -144.8 -145.0 -145.3 -145.5 -145.8 -146.0 -146.3 -146.5
NOARL Code 331



Calculated Sound Speed (m/s)
39.25,-143.00
GRID 2 TRACK C-b (1415-1425)
35.50,-145.25
1415
1416
1417
1418
1419
1420
1421
1422
1423
1424
1425
14:10:20
4/17/90
dx=19,dy=20,100
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
1498
1494
1492
1490
1488
1486
1484
1482
1480
1478
1476
1482
1486
1490
1494
1498
1502
1506
1510
1514
1518
1522
1526
1530
1534
1538
1542
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5
LONG -143.0 -143.3 -143.5 -143.8 -144.0 -144.3 -144.5 -144.8 -145.0 -145.3
NOARL Code 331

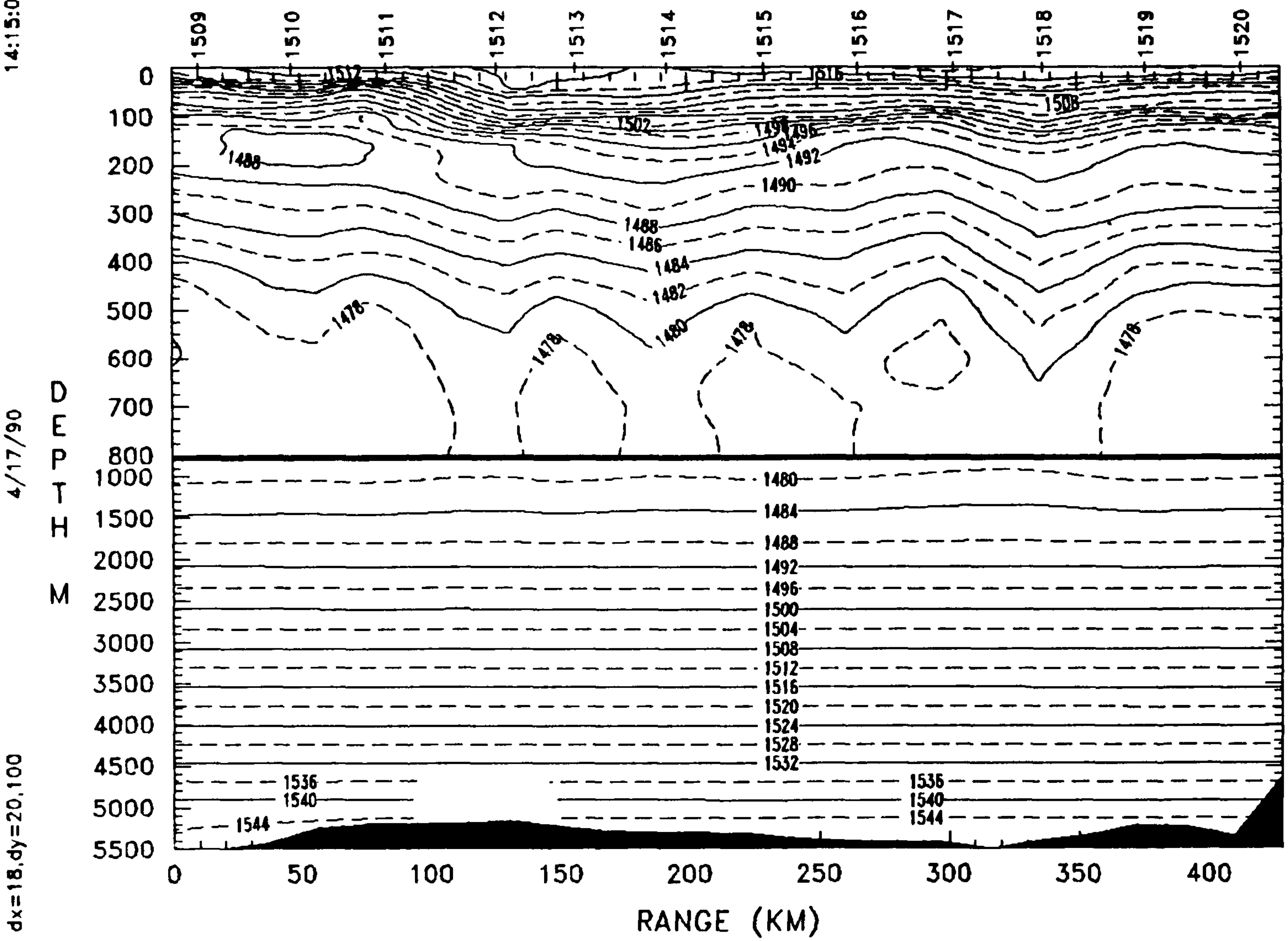


Calculated Sound Speed (m/s)
39.00,-142.50
GRID 2 TRACK C-c (1426-1436)
35.25,-144.75
14:11:55
4/17/90
dx=19,dy=20,100
1436 1435 1434 1433 1432 1431 1430 1429 1428 1427 1426
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
1510 1506 1504 1502 1516 1506 1492 1494 1490 1486 1488 1484 1482 1480 1478 1478
1478 1482 1486 1490 1494 1498 1502 1506 1510 1514 1518 1522 1526 1530 1534 1538 1542 1546
0 50 100 150 200 250 300 350 400 450
RANGE (KM)
LAT 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3
LONG -142.5 -142.8 -143.0 -143.3 -143.5 -143.8 -144.0 -144.3 -144.5 -144.8
NOARL Code 331


Calulated Sound Speed (m/s)
38.50,-142.00
GRID 2 TRACK D2-a (1501-1508)
35.00,-144.25
1508
1507
1506
1505
1504
1503
1502
1501
1516
1508
1490
1488
1486
1484
1482
1480
1478
1476
1480
1484
1488
1492
1496
1500
1504
1508
1512
1516
1520
1524
1528
1532
1536
1540
1544
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
DEPTH M
0 50 100 150 200 250 300 350 400
RANGE (KM)
LAT 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0
LONG -142.0 -142.3 -142.5 -142.8 -143.0 -143.3 -143.5 -143.8 -144.0 -144.3
NOARL Code 331
14:13:27
4/17/90
dx=19,dy=20,100

Calculated Sound Speed (m/s)

38.25,−141.50 GRID 2 TRACK D2-b (1509−1520) 34.75,−143.50

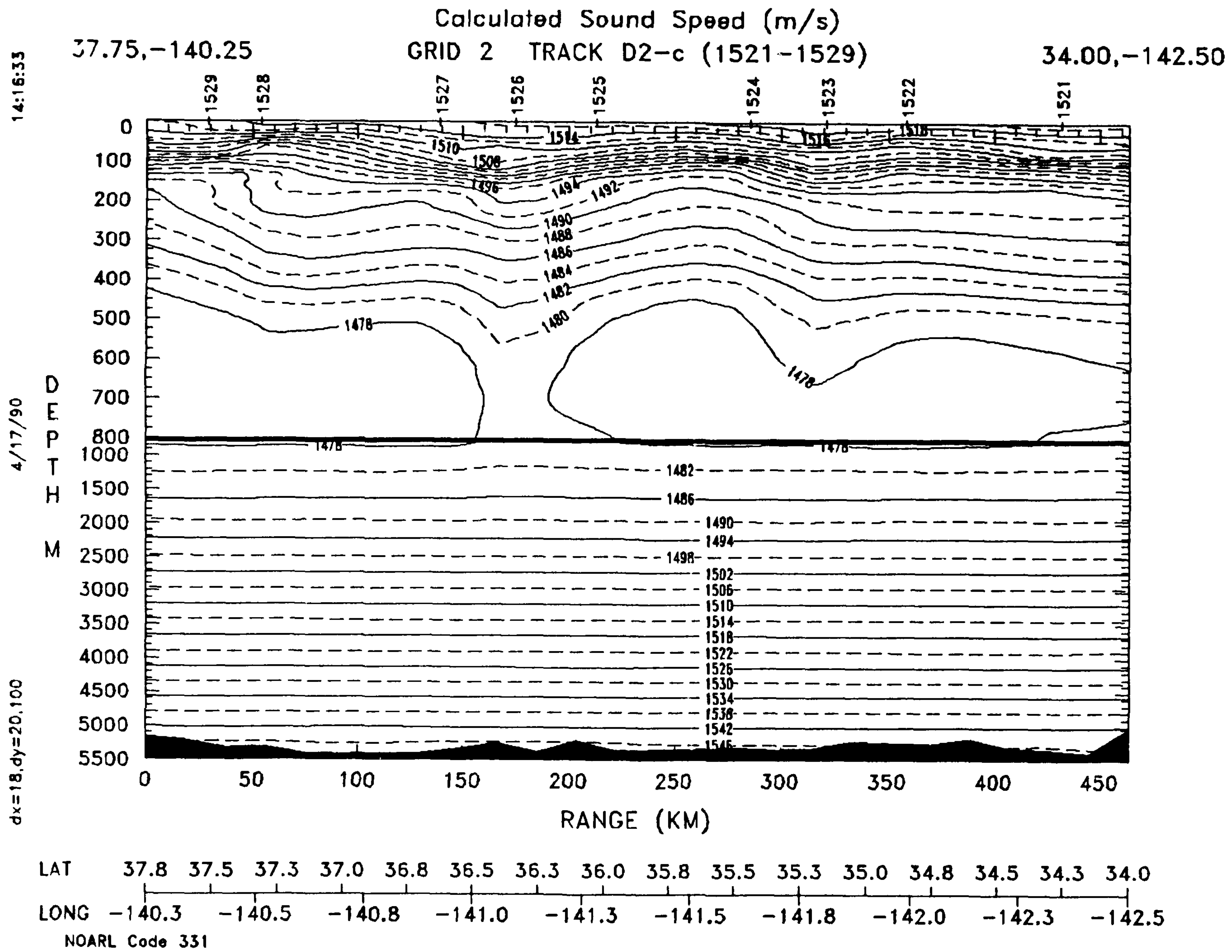


NOARL Code 331

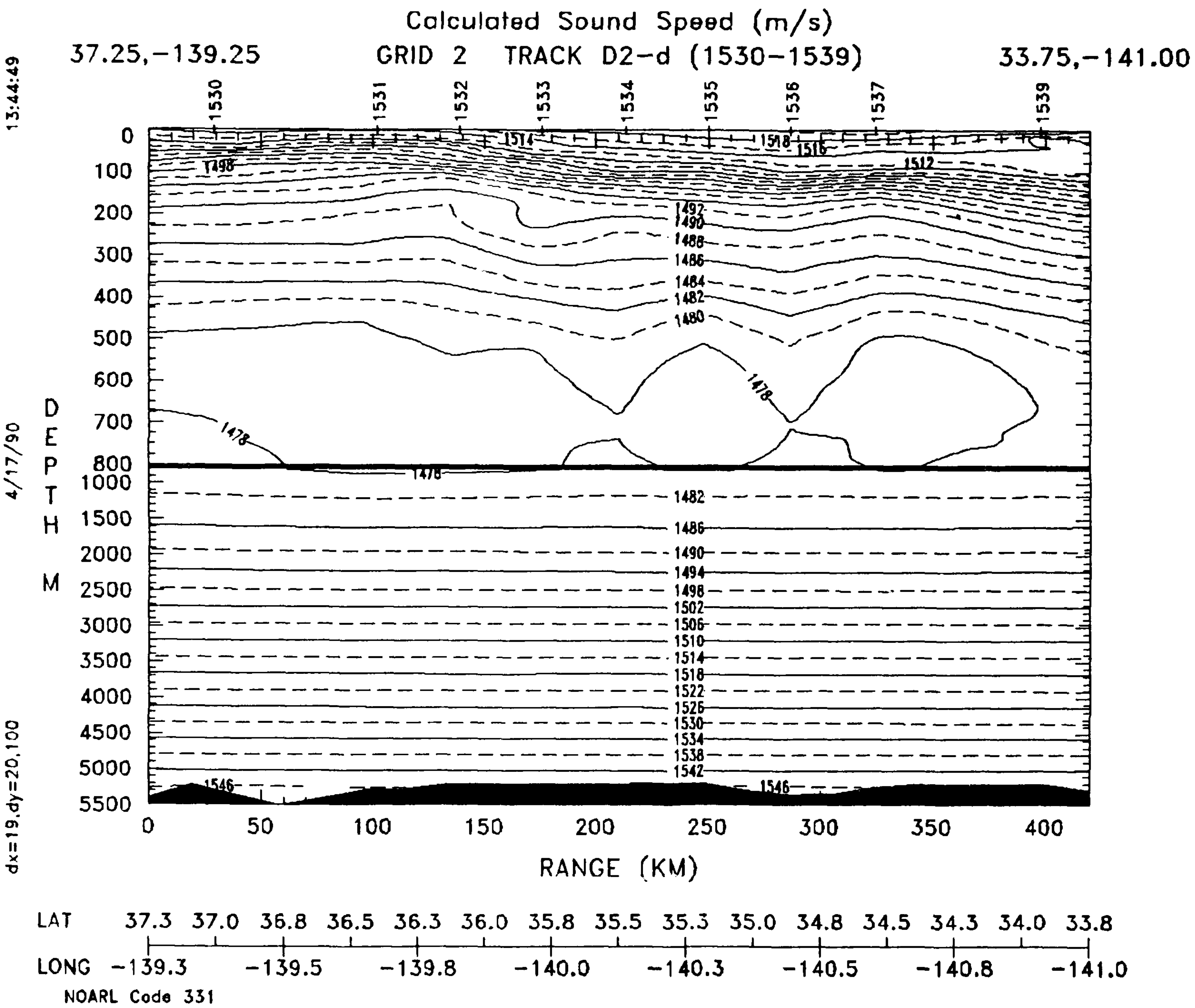
14:15:00

4/17/90

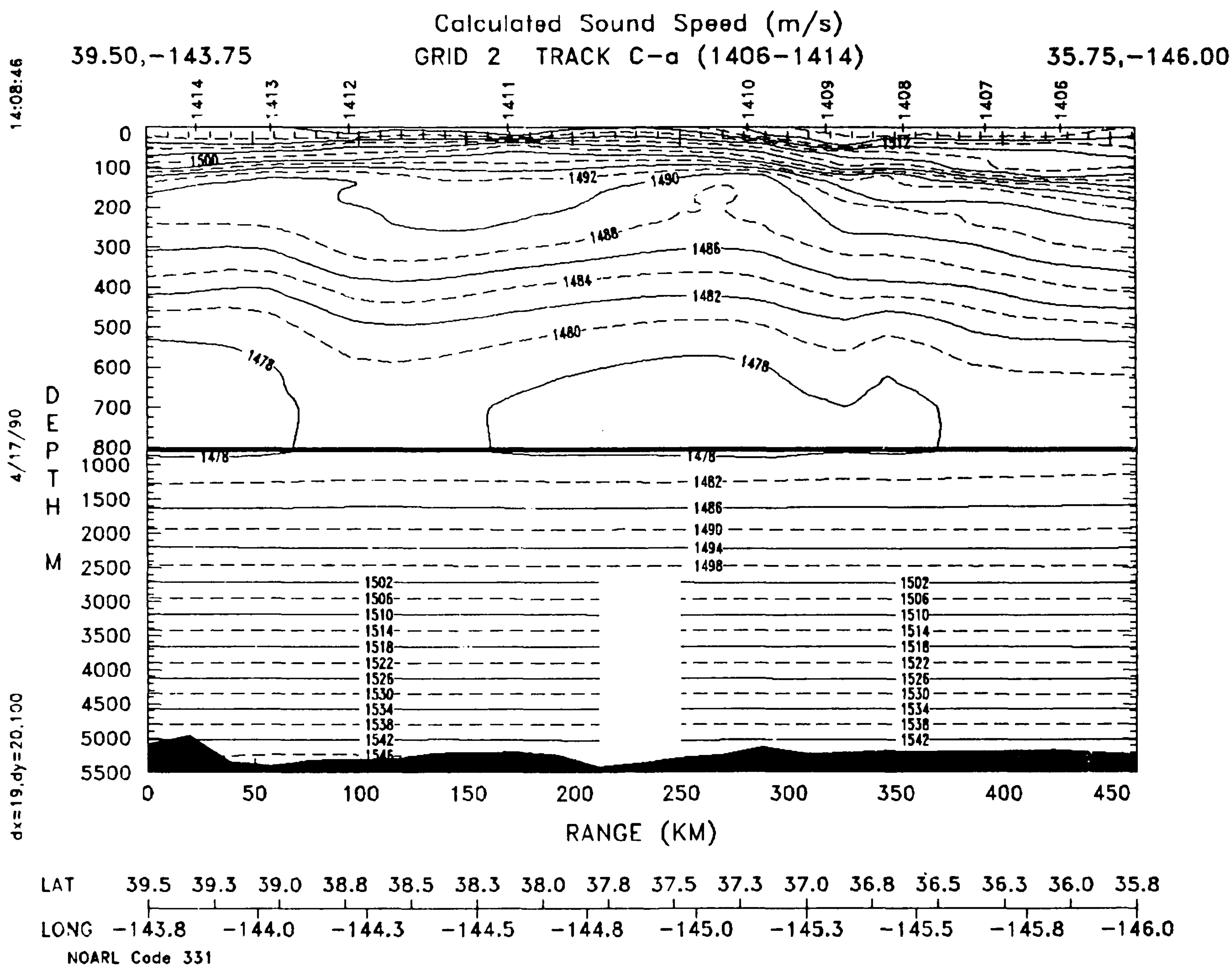
dx=18,dy=20,100



Calculated Sound Speed (m/s)
37.75,-140.25
GRID 2 TRACK D2-c (1521-1529)
34.00,-142.50
14:16:33
4/17/90
dx=18,dy=20,100
1529
1528
1527
1526
1525
1524
1523
1522
1521
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
1510
1508
1514
1496
1494
1492
1490
1488
1486
1484
1482
1480
1478
1482
1486
1490
1494
1498
1502
1506
1510
1514
1518
1522
1526
1530
1534
1538
1542
RANGE (KM)
0
50
100
150
200
250
300
350
400
450
LAT 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0 34.8 34.5 34.3 34.0
LONG -140.3 -140.5 -140.8 -141.0 -141.3 -141.5 -141.8 -142.0 -142.3 -142.5
NOARL Code 331



Calculated Sound Speed (m/s)
37.25,-139.25
GRID 2 TRACK D2-d (1530-1539)
33.75,-141.00
1530 1531 1532 1533 1534 1535 1536 1537 1539
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
1498 1514 1518 1516 1512 1492 1490 1488 1486 1484 1482 1480 1478
1482 1486 1490 1494 1498 1502 1506 1510 1514 1518 1522 1526 1530 1534 1538 1542 1546
0 50 100 150 200 250 300 350 400
RANGE (KM)
LAT 37.3 37.0 36.8 36.5 36.3 36.0 35.8 35.5 35.3 35.0 34.8 34.5 34.3 34.0 33.8
LONG -139.3 -139.5 -139.8 -140.0 -140.3 -140.5 -140.8 -141.0
NOARL Code 331
13:44:49
4/17/90
dx=19,dy=20,100


Calculated Sound Speed (m/s)
39.50,-143.75
GRID 2 TRACK C-a (1406-1414)
35.75,-146.00
14:08:46
4/17/90
dx=19,dy=20,100
1414
1413
1412
1411
1410
1409
1408
1407
1406
DEPTH M
0
100
200
300
400
500
600
700
800
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
1500
1492
1490
1488
1486
1484
1482
1480
1478
1512
1494
1498
1502
1506
1510
1514
1518
1522
1526
1530
1534
1538
1542
1546
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT 39.5 39.3 39.0 38.8 38.5 38.3 38.0 37.8 37.5 37.3 37.0 36.8 36.5 36.3 36.0 35.8
LONG -143.8 -144.0 -144.3 -144.5 -144.8 -145.0 -145.3 -145.5 -145.8 -146.0
NOARL Code 331

Appendix L

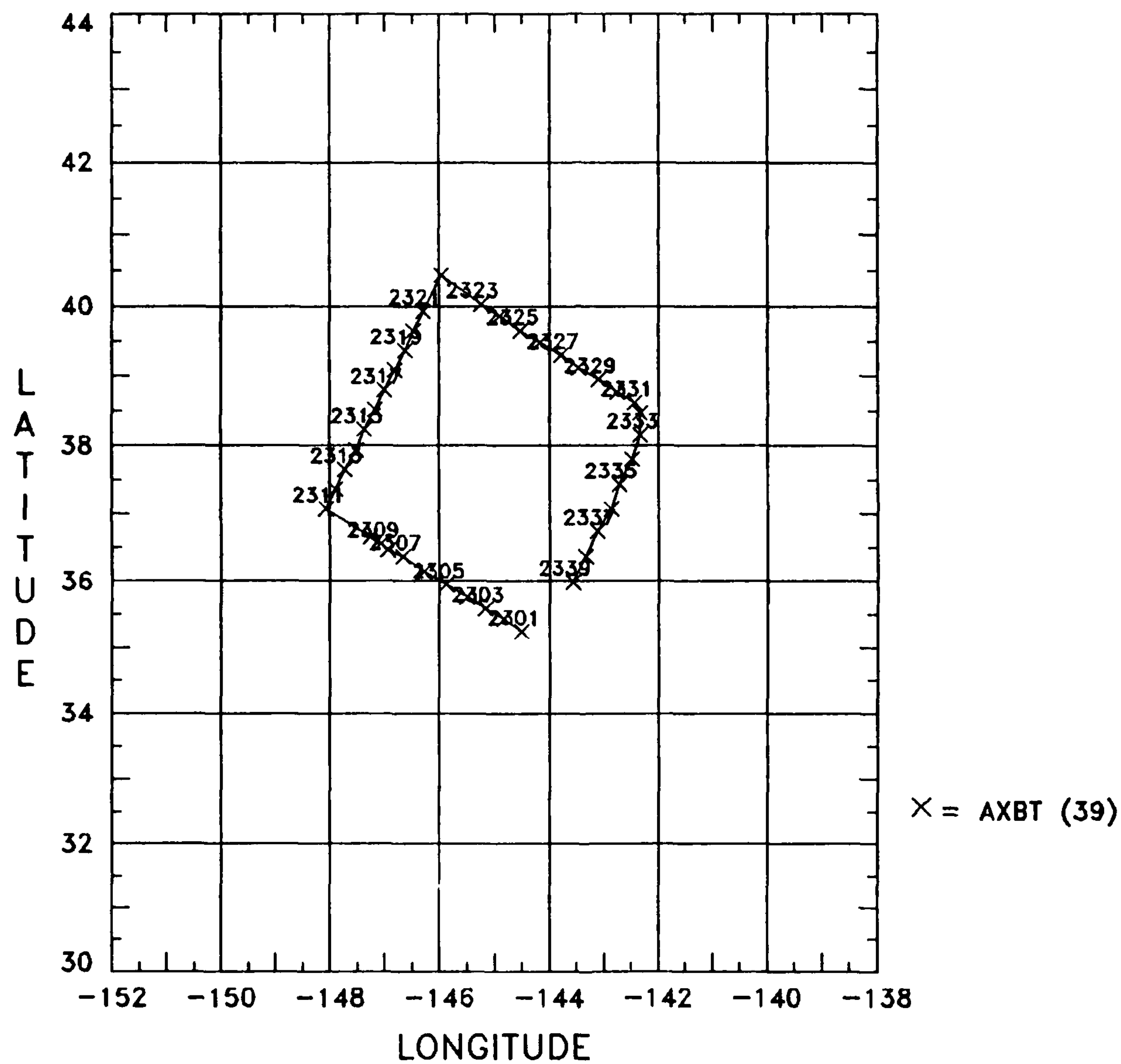
NEPAC Boundary Flight 2 (12 July 1989)

Vertical Temperature Contours along All 4 Sides

Surface to 300 m

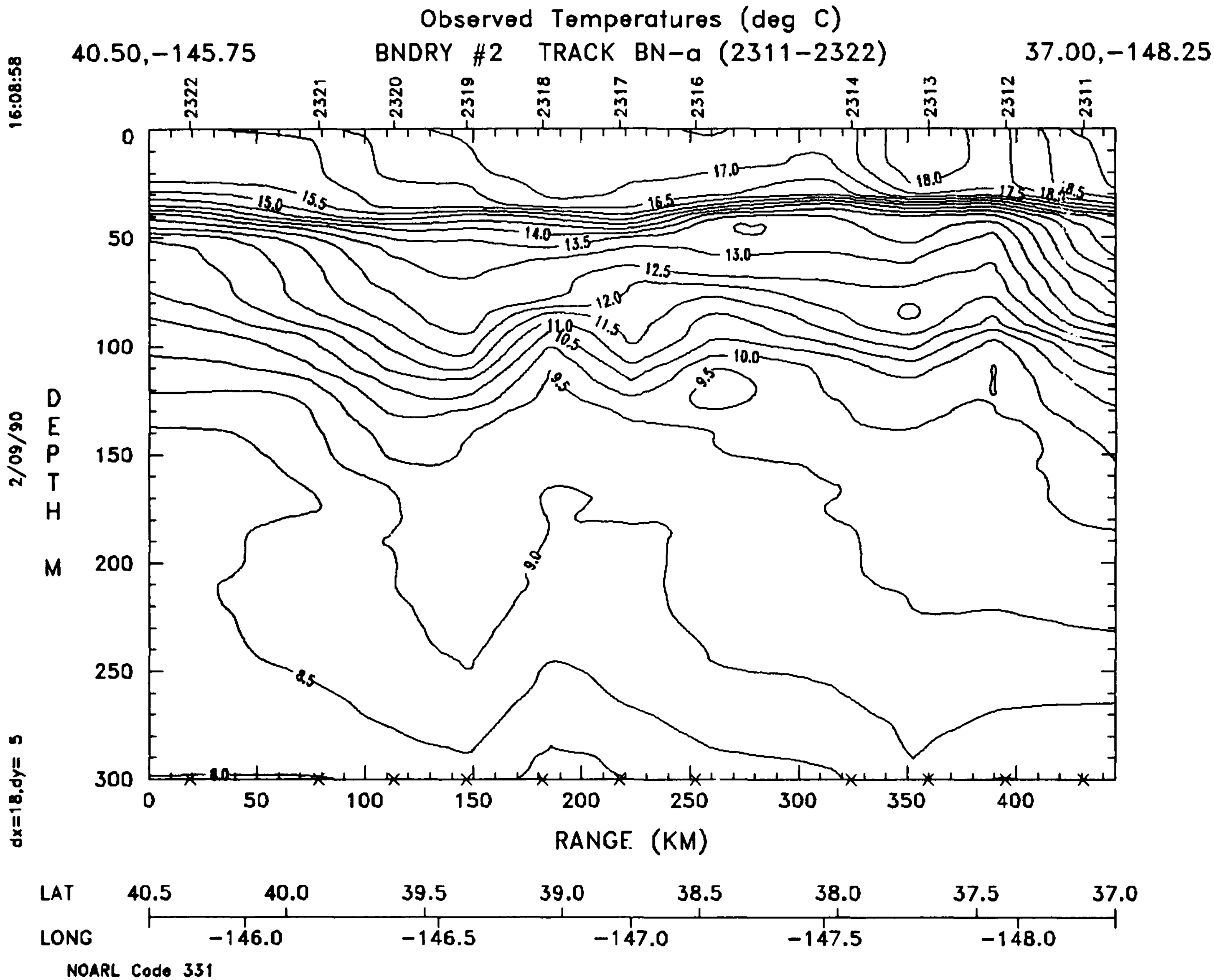
NEPAC Boundary 2

39 Probes

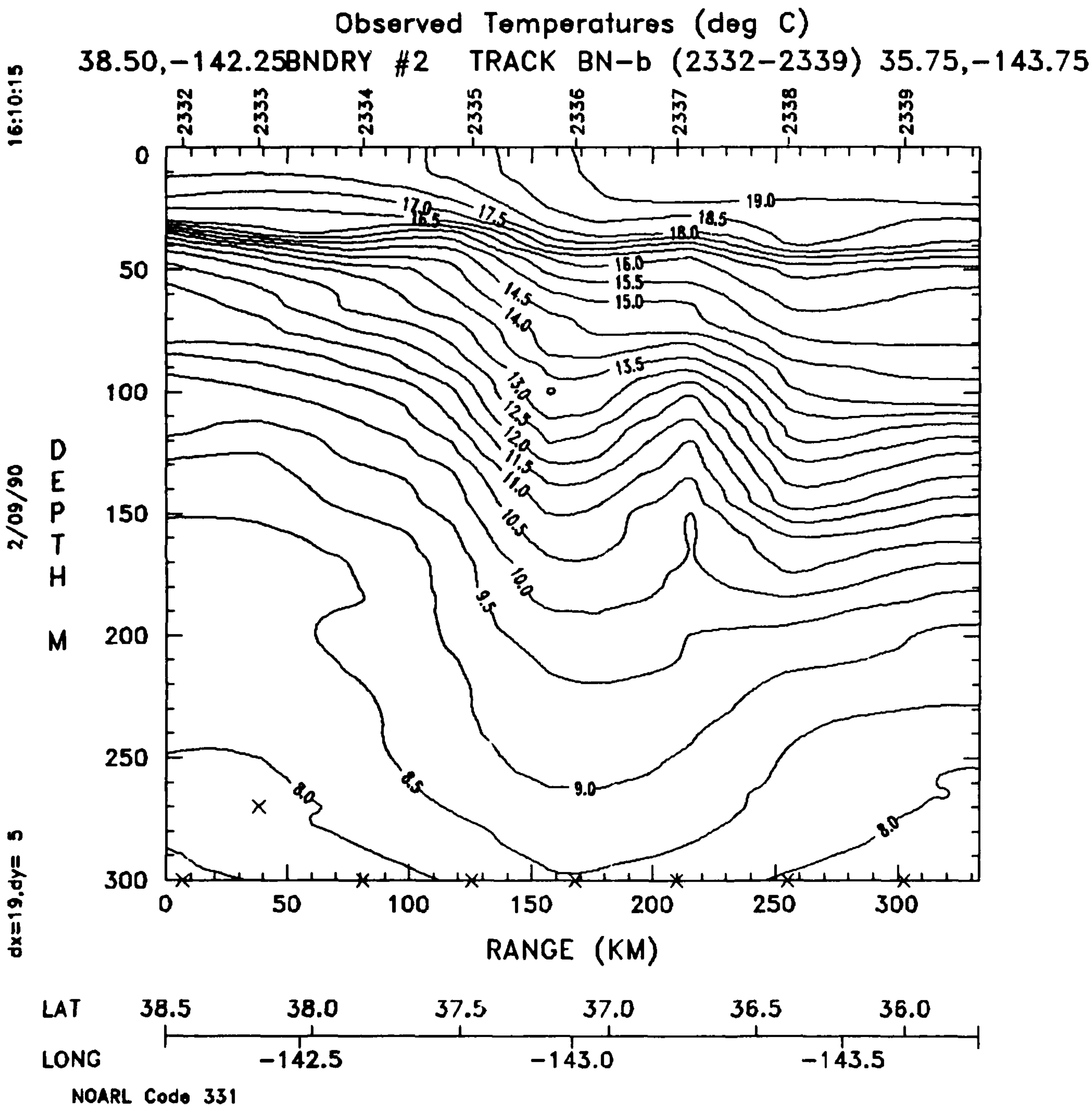


NOARL Code 331

11/28/89 13:14:59

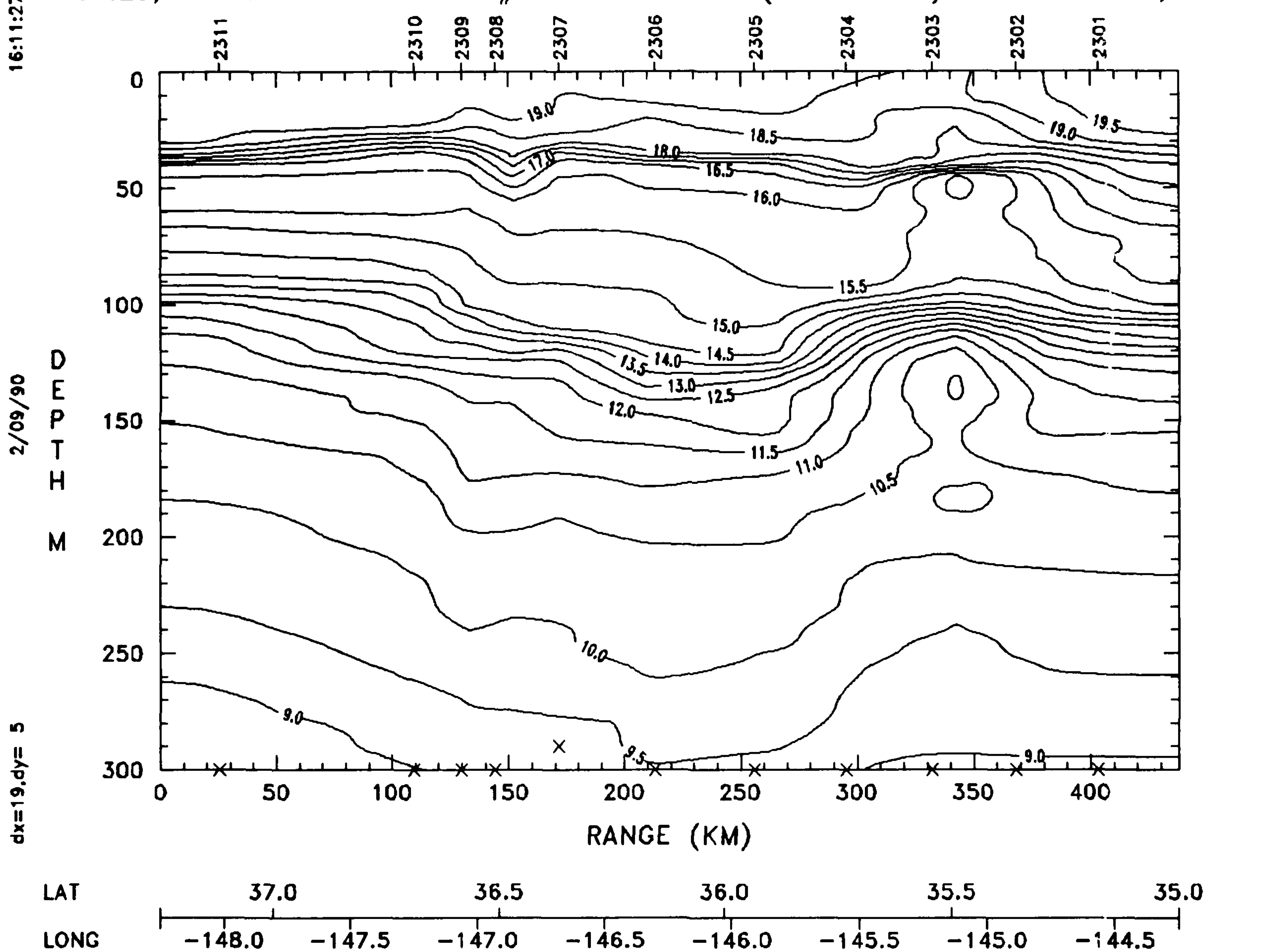


Observed Temperatures (deg C)
40.50,-145.75
BNDRY #2 TRACK BN-a (2311-2322)
37.00,-148.25
16:08:58
2/09/90
dx=18,dy= 5
2322
2321
2320
2319
2318
2317
2316
2314
2313
2312
2311
DEPTH M
0
50
100
150
200
250
300
17.0
18.0
17.5
18.5
16.5
15.0
15.5
14.0
13.5
13.0
12.5
12.0
11.0
11.5
10.5
10.0
9.5
9.0
8.5
8.0
RANGE (KM)
0
50
100
150
200
250
300
350
400
LAT
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
LONG
-146.0
-146.5
-147.0
-147.5
-148.0
NOARL Code 331

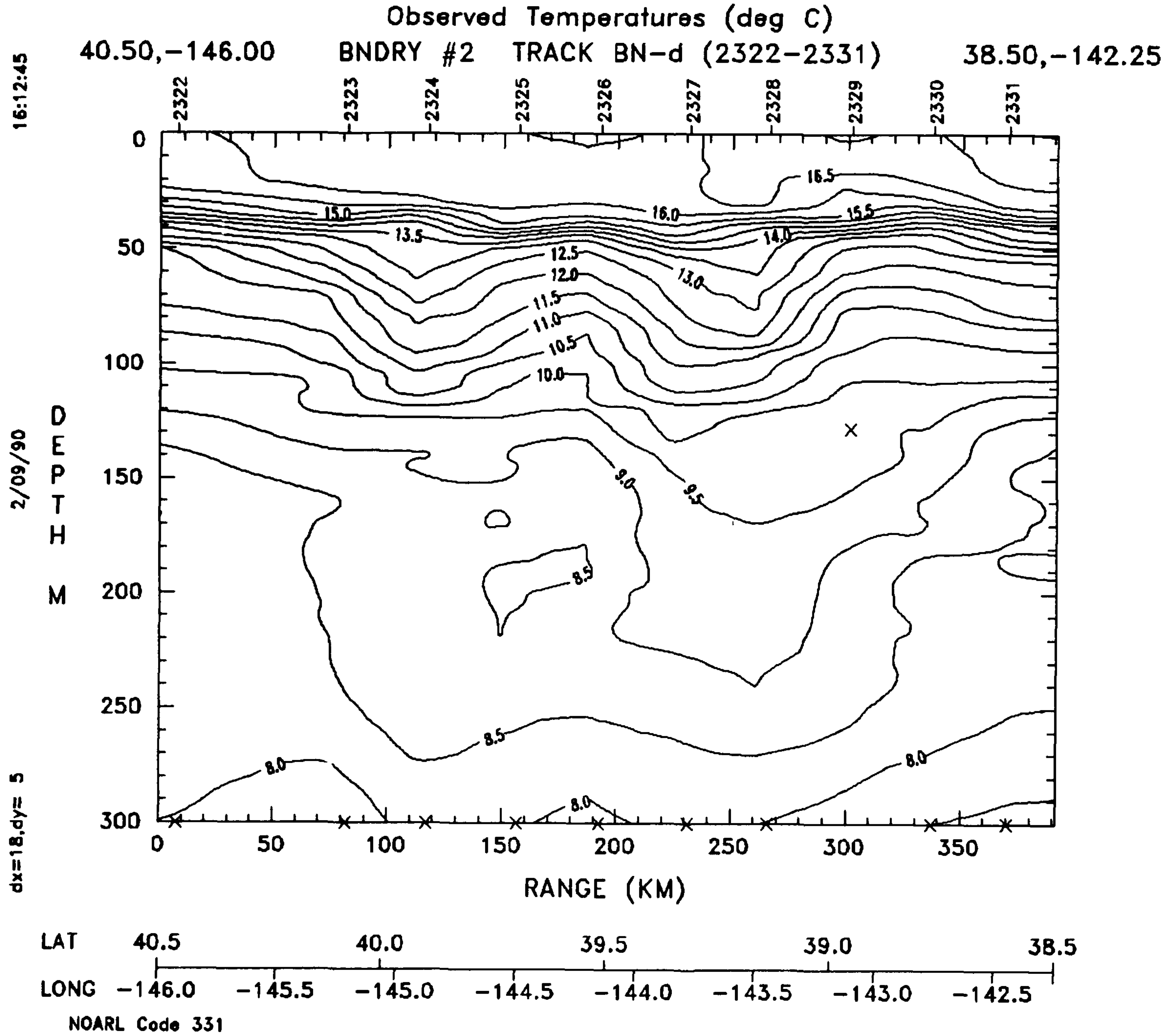

Observed Temperatures (deg C)
38.50,-142.25BNDRY #2 TRACK BN-b (2332-2339) 35.75,-143.75
16:10:15
2/09/90
dx=19,dy= 5
2332
2333
2334
2335
2336
2337
2338
2339
DEPTH M
0
50
100
150
200
250
300
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
RANGE (KM)
LAT
38.5
38.0
37.5
37.0
36.5
36.0
LONG
-142.5
-143.0
-143.5
NOARL Code 331

Observed Temperatures (deg C)

37.25,-148.25 BNDRY #2 TRACK BN-c (2301-2311) 35.00,-144.25



NOARL Code 331


Observed Temperatures (deg C)
40.50,-146.00
BNDRY #2 TRACK BN-d (2322-2331)
38.50,-142.25
2322
2323
2324
2325
2326
2327
2328
2329
2330
2331
16:12:45
2/09/90
dx=18,dy= 5
DEPTH M
0
50
100
150
200
250
300
16.5
16.0
15.5
15.0
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
RANGE (KM)
350
LAT
40.5
40.0
39.5
39.0
38.5
LONG
-146.0
-145.5
-145.0
-144.5
-144.0
-143.5
-143.0
-142.5
NOARL Code 331

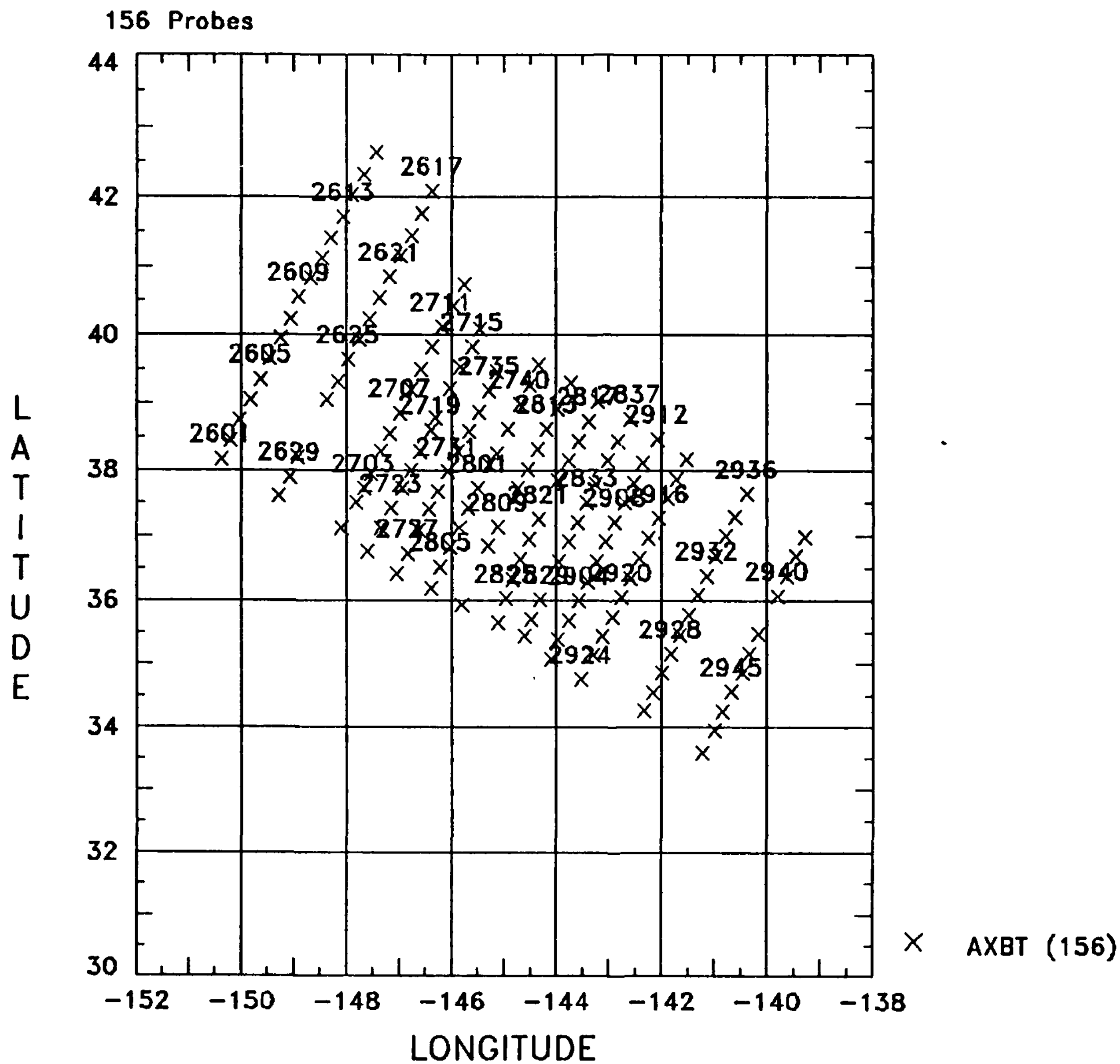
Appendix M

NEPAC Grid 3 (17 - 19 July 1989)

Temperature Contours along Selected Vertical Transects

Surface to 300 m

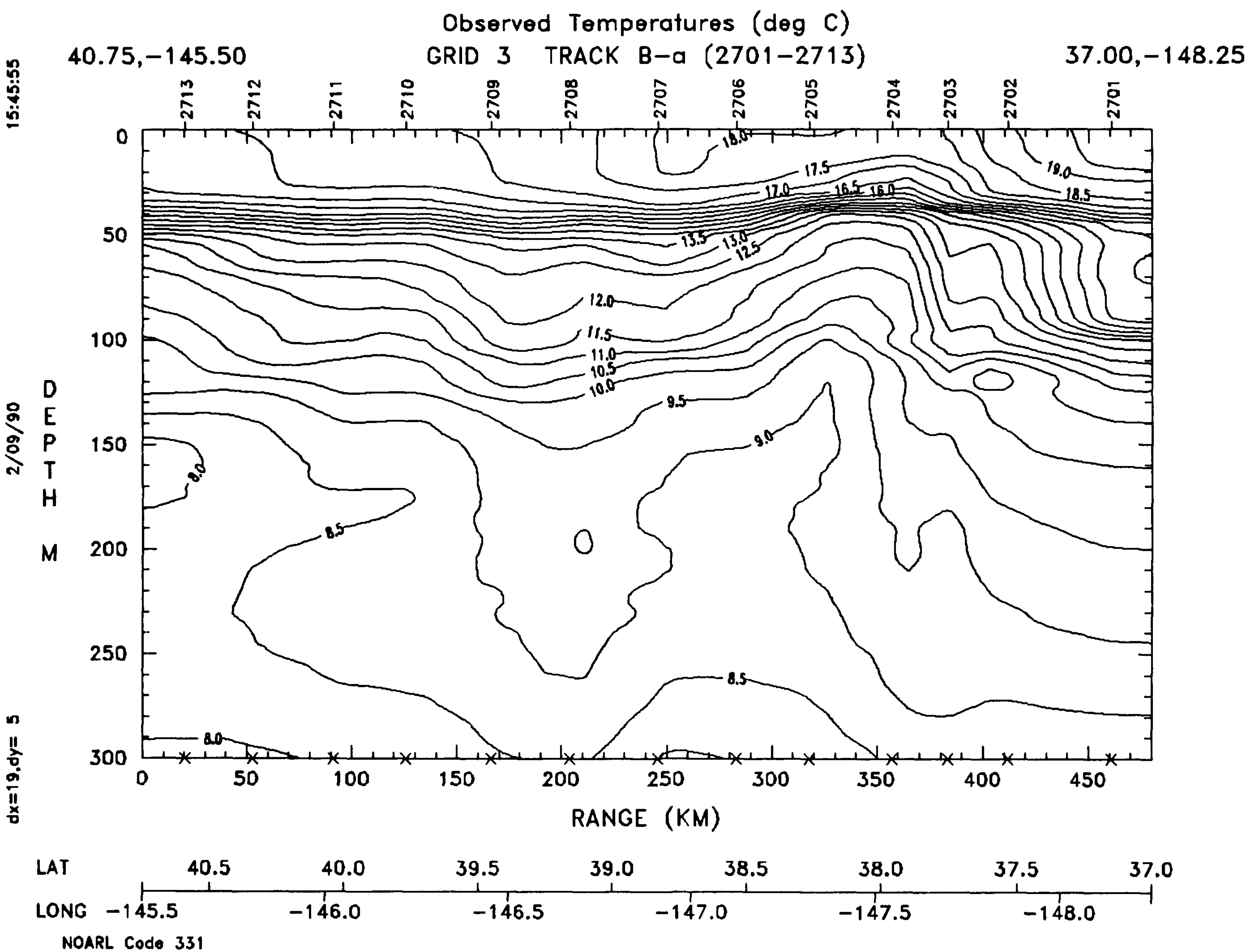
NEPAC Grid 3 (17–19 July 1989)



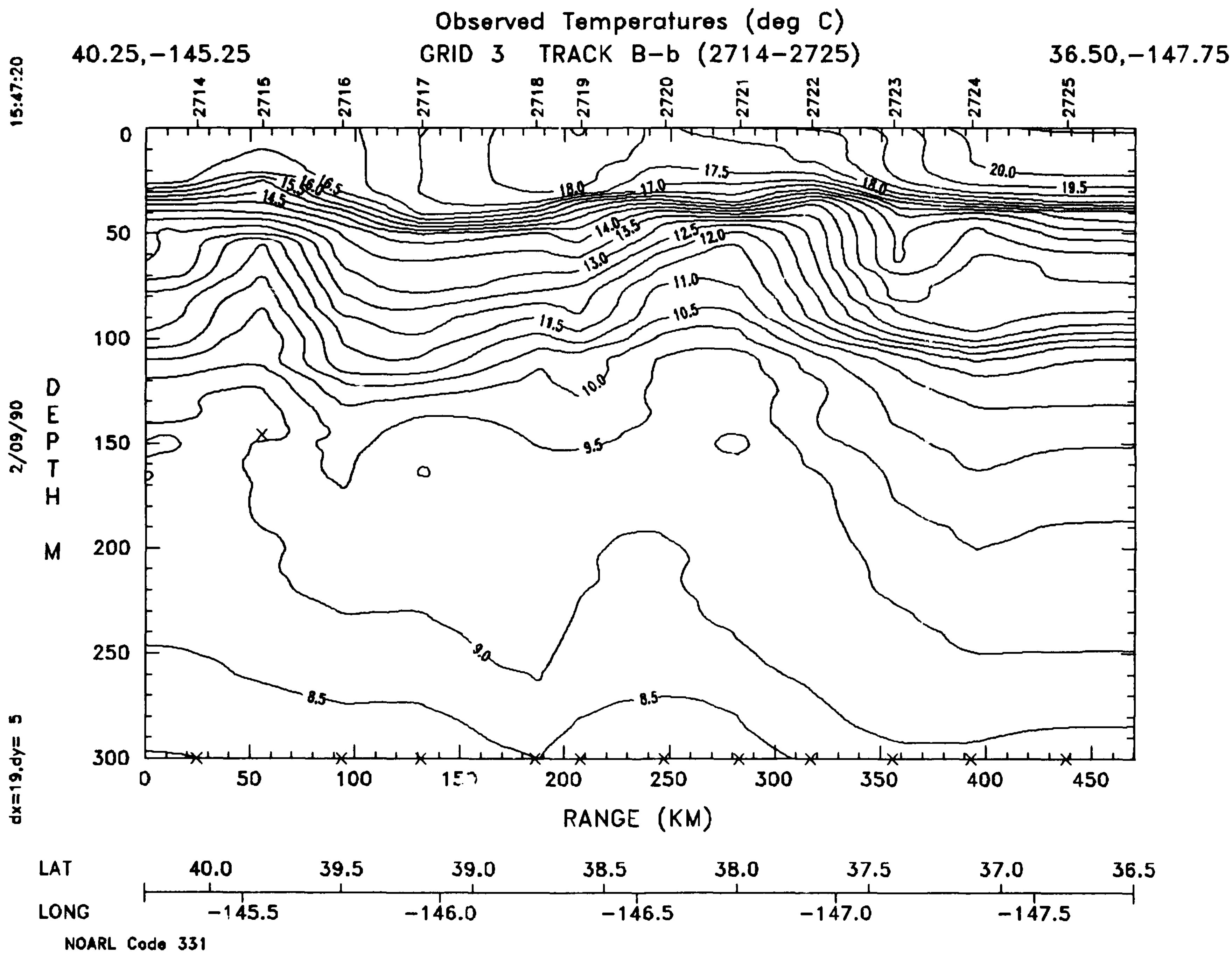
NOARL Code 331

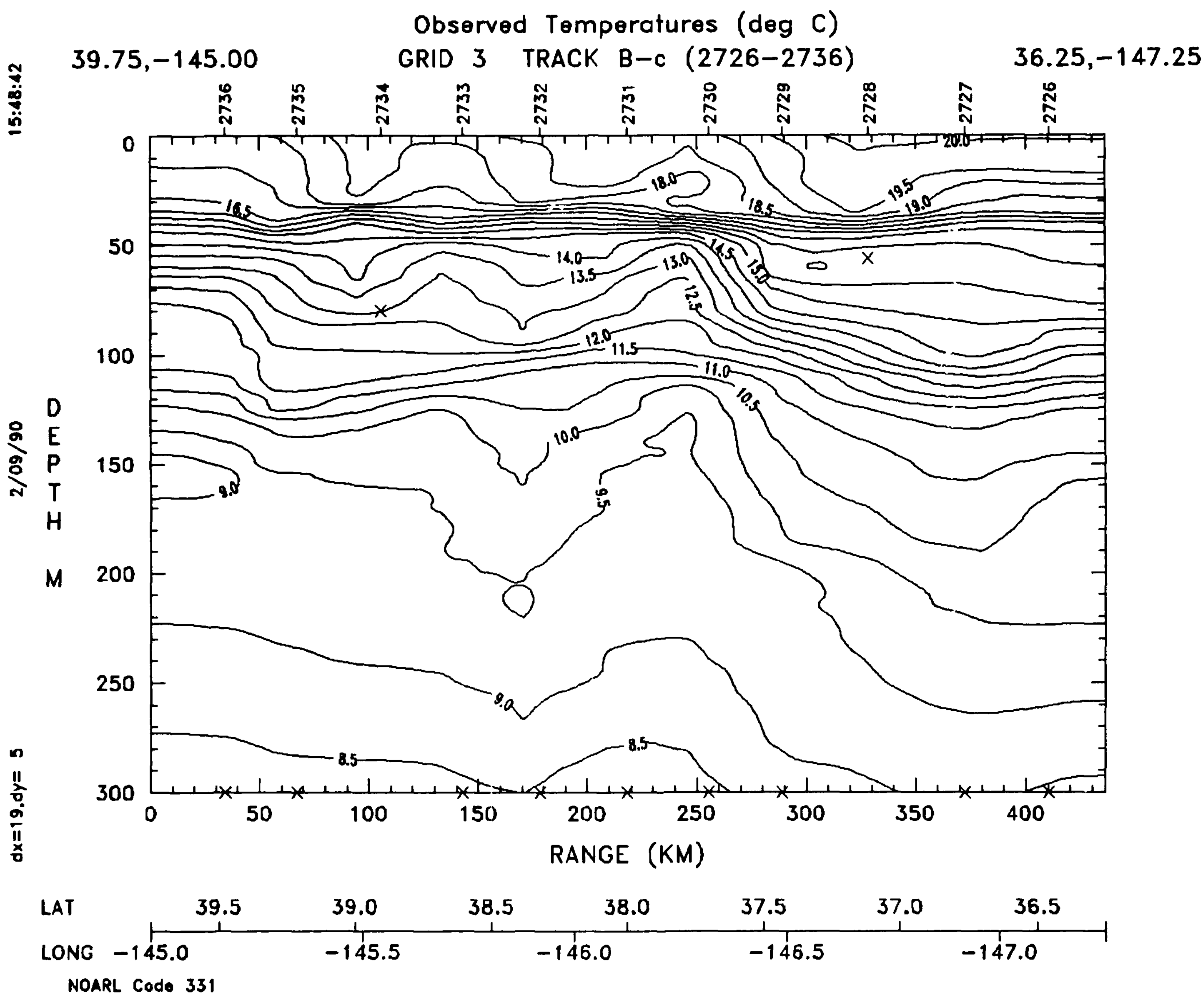
9:01:40

5/09/90

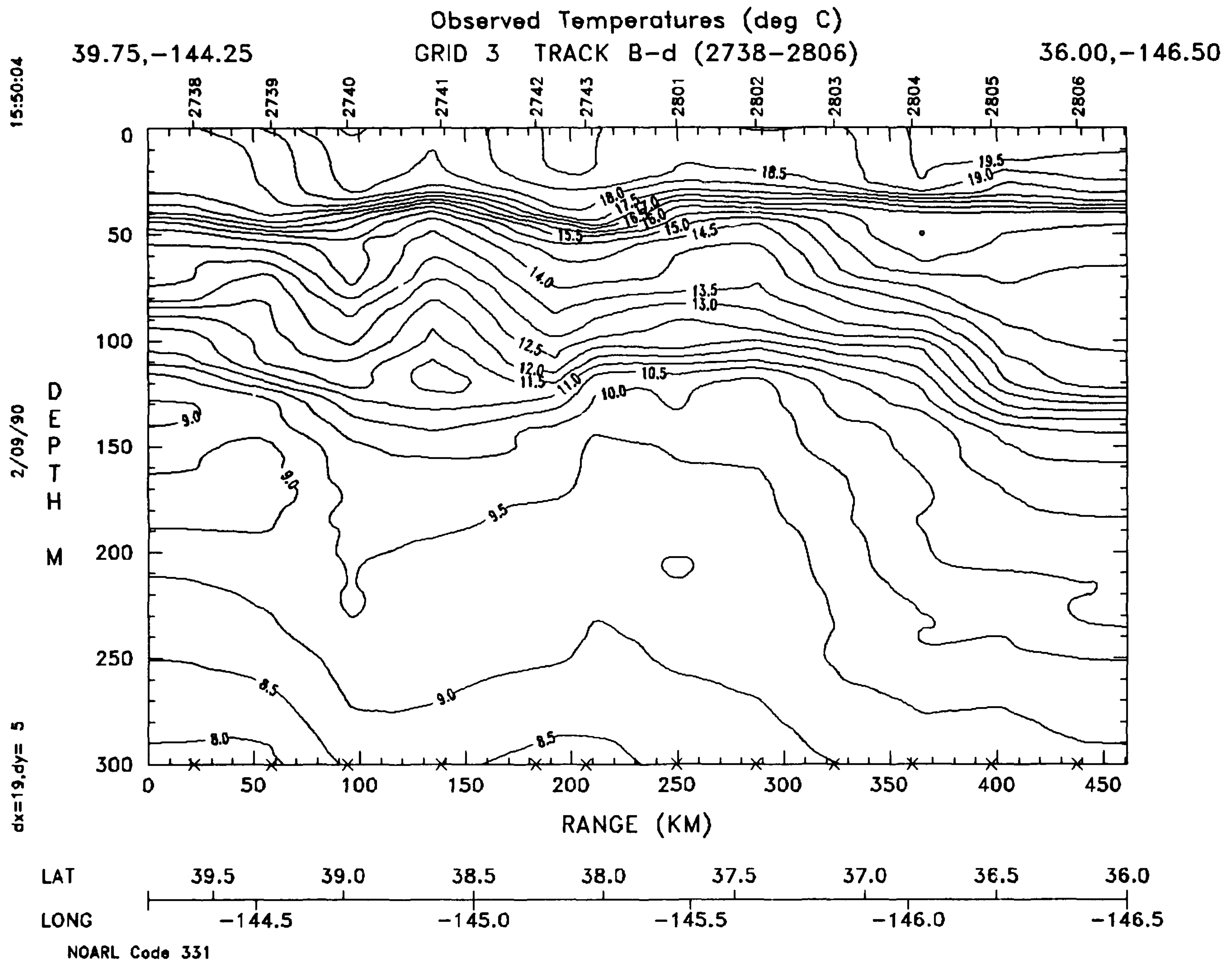


Observed Temperatures (deg C)
40.75,-145.50
GRID 3 TRACK B-a (2701-2713)
37.00,-148.25
2713
2712
2711
2710
2709
2708
2707
2706
2705
2704
2703
2702
2701
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331
15:45:55
2/09/90
dx=19,dy= 5

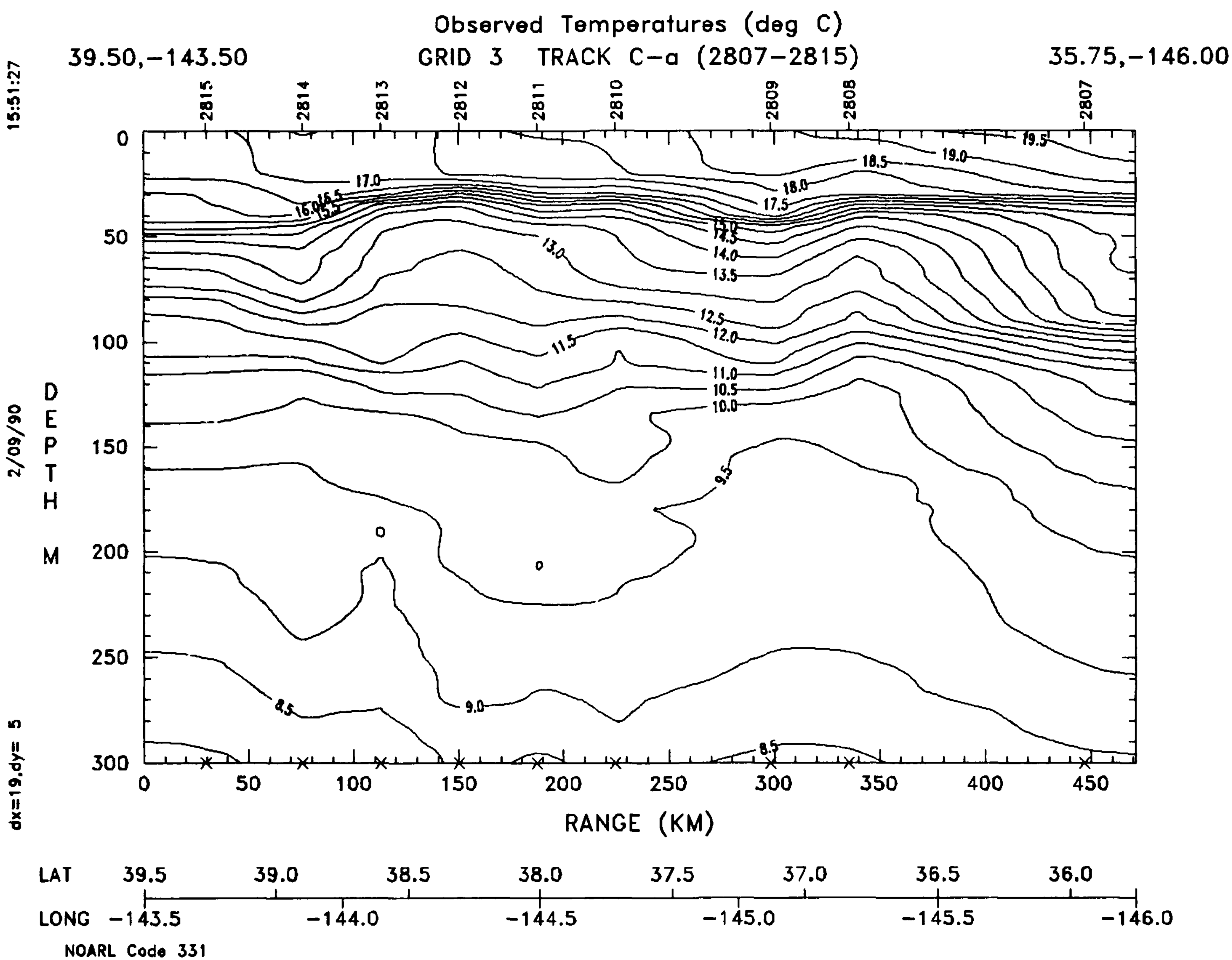

Observed Temperatures (deg C)
40.25,-145.25
GRID 3 TRACK B-b (2714-2725)
36.50,-147.75
15:47:20
2/09/90
dx=19,dy= 5
2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725
DEPTH M
0 50 100 150 200 250 300
RANGE (KM)
0 50 100 150 200 250 300 350 400 450
20.0 19.5 18.0 17.5 17.0 16.5 16.0 15.5 14.5 14.0 13.5 13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5
LAT 40.0 39.5 39.0 38.5 38.0 37.5 37.0 36.5
LONG −145.5 −146.0 −146.5 −147.0 −147.5
NOARL Code 331



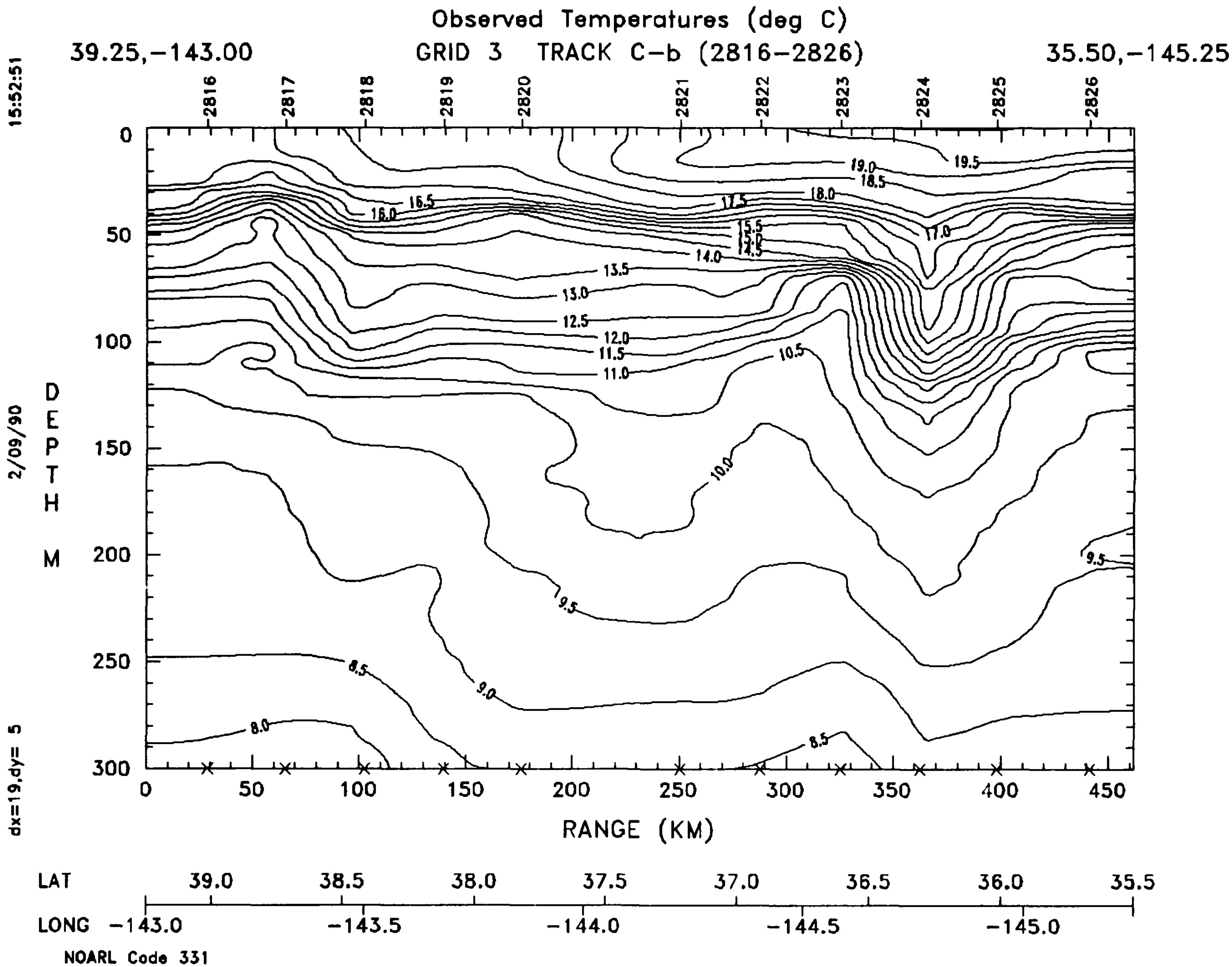
Observed Temperatures (deg C)
39.75,-145.00
GRID 3 TRACK B-c (2726-2736)
36.25,-147.25
2736
2735
2734
2733
2732
2731
2730
2729
2728
2727
2726
15:48:42
2/09/90
dx=19,dy= 5
DEPTH M
0
50
100
150
200
250
300
20.0
19.5
19.0
18.0
18.5
16.5
14.0
14.5
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
0
50
100
150
200
250
300
350
400
RANGE (KM)
LAT
39.5
39.0
38.5
38.0
37.5
37.0
36.5
LONG
-145.0
-145.5
-146.0
-146.5
-147.0
NOARL Code 331



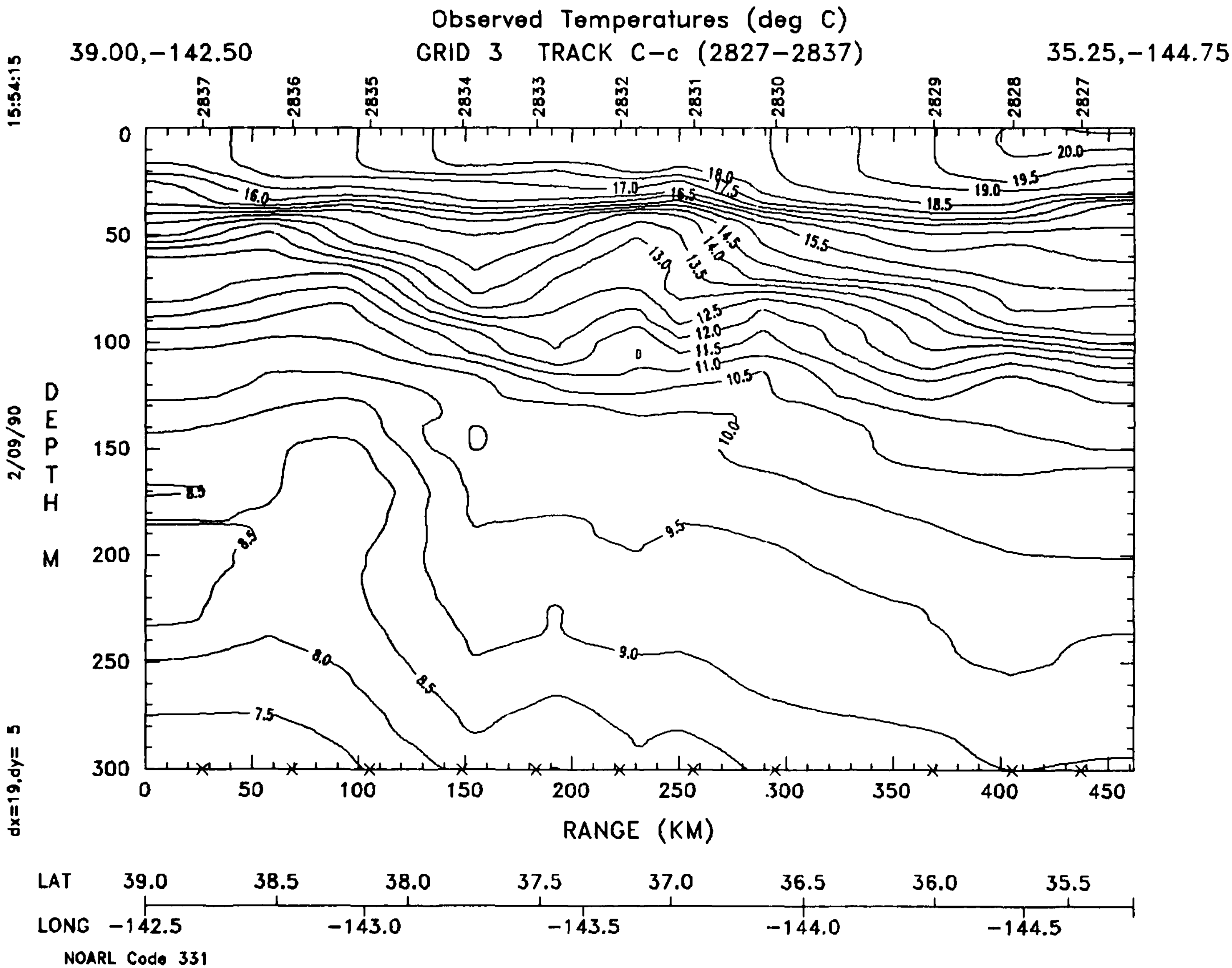
Observed Temperatures (deg C)
39.75,-144.25
GRID 3 TRACK B-d (2738-2806)
36.00,-146.50
2738
2739
2740
2741
2742
2743
2801
2802
2803
2804
2805
2806
15:50:04
2/09/90
dx=19,dy= 5
DEPTH M
0
50
100
150
200
250
300
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
0
50
100
150
200
250
300
350
400
450
RANGE (KM)
LAT
39.5
39.0
38.5
38.0
37.5
37.0
36.5
36.0
LONG
-144.5
-145.0
-145.5
-146.0
-146.5
NOARL Code 331



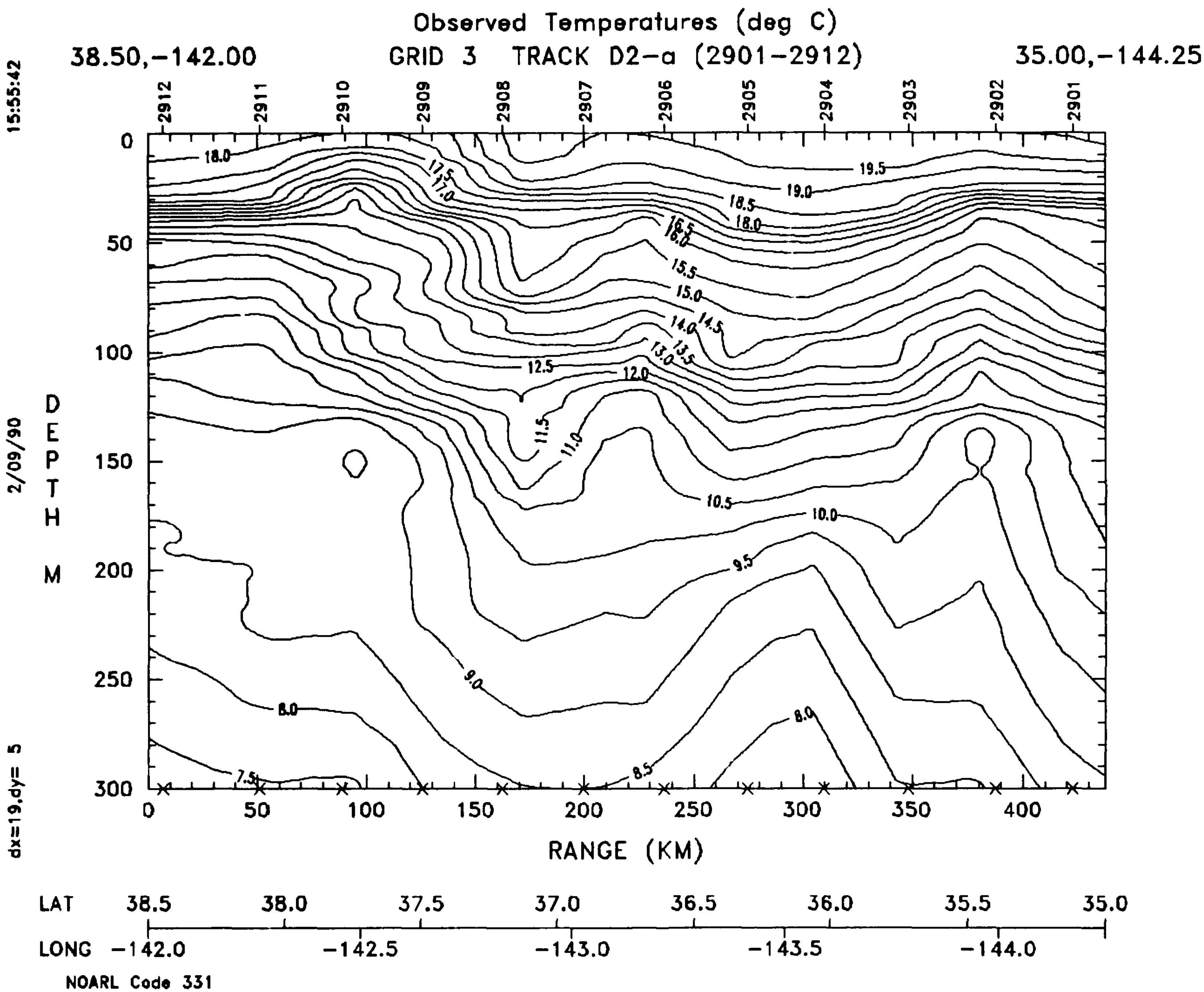
Observed Temperatures (deg C)
39.50,-143.50
GRID 3 TRACK C-a (2807-2815)
35.75,-146.00
15:51:27
2/09/90
dx=19,dy= 5
2815
2814
2813
2812
2811
2810
2809
2808
2807
DEPTH M
RANGE (KM)
LAT 39.5 39.0 38.5 38.0 37.5 37.0 36.5 36.0
LONG -143.5 -144.0 -144.5 -145.0 -145.5 -146.0
NOARL Code 331



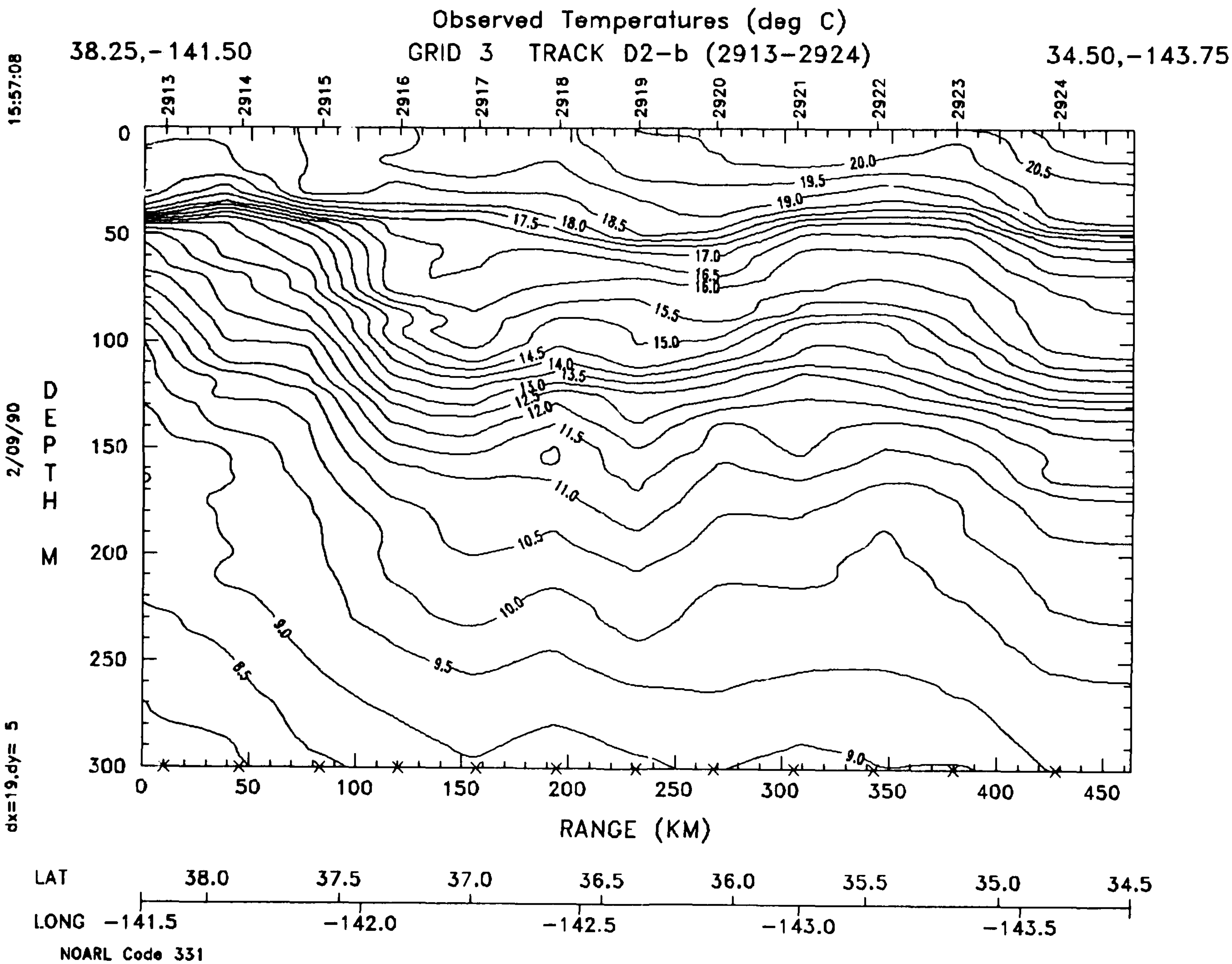
Observed Temperatures (deg C)
39.25,-143.00
GRID 3 TRACK C-b (2816-2826)
35.50,-145.25
2816
2817
2818
2819
2820
2821
2822
2823
2824
2825
2826
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
LAT
39.0
38.5
38.0
37.5
37.0
36.5
36.0
35.5
LONG
-143.0
-143.5
-144.0
-144.5
-145.0
NOARL Code 331
15:52:51
2/09/90
dx=19,dy= 5

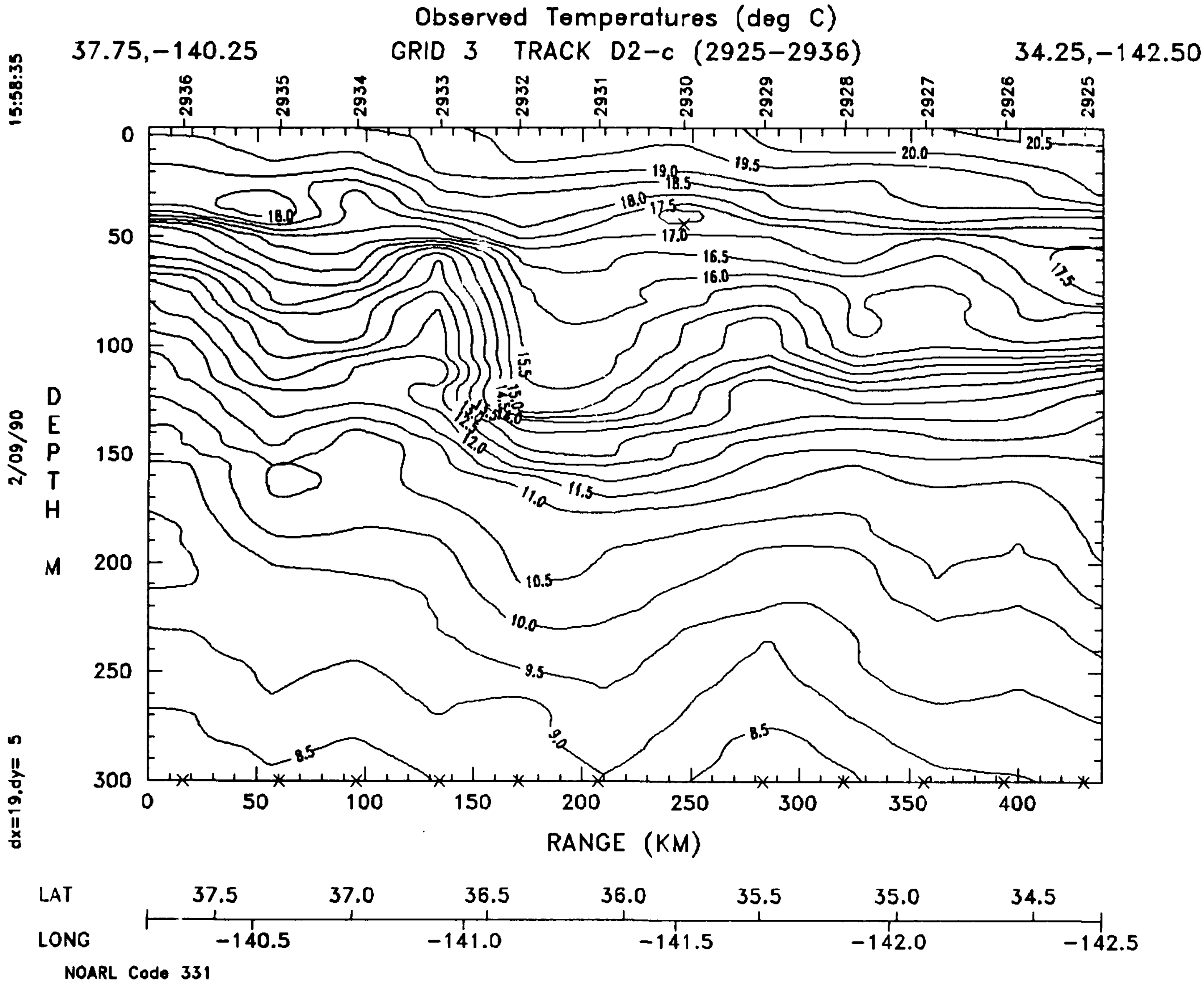


Observed Temperatures (deg C)
39.00,-142.50
GRID 3 TRACK C-c (2827-2837)
35.25,-144.75
2837
2836
2835
2834
2833
2832
2831
2830
2829
2828
2827
DEPTH M
RANGE (KM)
LAT
LONG
15:54:15
2/09/90
dx=19,dy= 5
NOARL Code 331

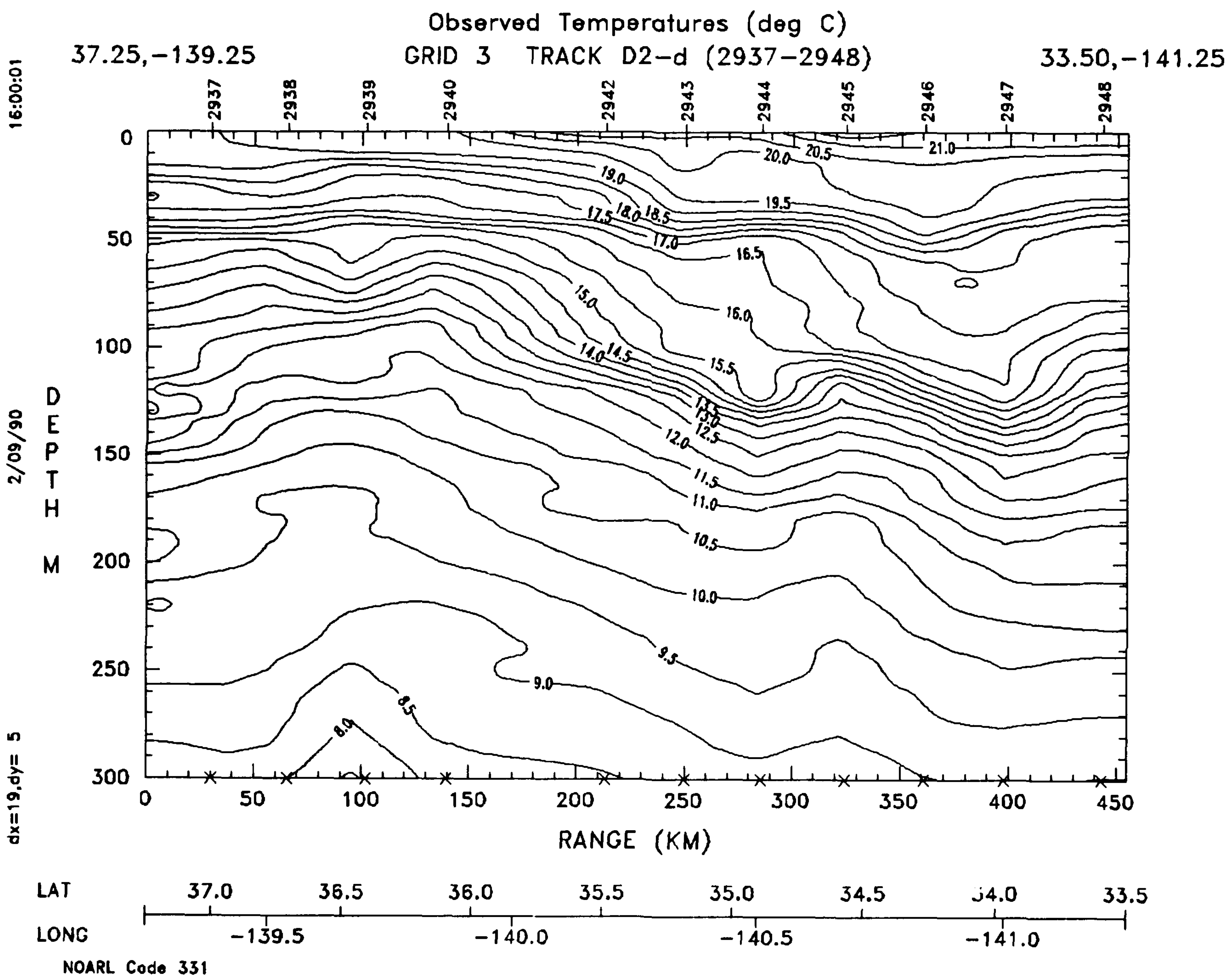


Observed Temperatures (deg C)
38.50,-142.00
GRID 3 TRACK D2-a (2901-2912)
35.00,-144.25
2912
2911
2910
2909
2908
2907
2906
2905
2904
2903
2902
2901
15:55:42
2/09/90
dx=19,dy= 5
DEPTH M
0
50
100
150
200
250
300
18.0
17.5
17.0
19.5
19.0
18.5
18.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.0
8.0
8.5
7.5
RANGE (KM)
100
150
200
250
300
350
400
LAT
38.5
38.0
37.5
37.0
36.5
36.0
35.5
35.0
LONG
-142.0
-142.5
-143.0
-143.5
-144.0
NOARL Code 331


15:57:08
2/09/90
dx=19.dy= 5
Observed Temperatures (deg C)
38.25,-141.50
GRID 3 TRACK D2-b (2913-2924)
34.50,-143.75
2913
2914
2915
2916
2917
2918
2919
2920
2921
2922
2923
2924
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331



Observed Temperatures (deg C)
37.75,-140.25
GRID 3 TRACK D2-c (2925-2936)
34.25,-142.50
15:58:35
2/09/90
dx=19,dy= 5
2936
2935
2934
2933
2932
2931
2930
2929
2928
2927
2926
2925
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
350
400
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
LAT
37.5
37.0
36.5
36.0
35.5
35.0
34.5
LONG
-140.5
-141.0
-141.5
-142.0
-142.5
NOARL Code 331



Observed Temperatures (deg C)
37.25,-139.25
GRID 3 TRACK D2-d (2937-2948)
33.50,-141.25
16:00:01
2/09/90
dx=19,dy= 5
2937
2938
2939
2940
2942
2943
2944
2945
2946
2947
2948
DEPTH M
0
50
100
150
200
250
300
RANGE (KM)
0
50
100
150
200
250
300
350
400
450
21.0
20.5
20.0
19.5
19.0
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
LAT
37.0
36.5
36.0
35.5
35.0
34.5
34.0
33.5
LONG
-139.5
-140.0
-140.5
-141.0
NOARL Code 331

Appendix N

First GEOSAT Underflight, 28 June 1989

Vertical Contours

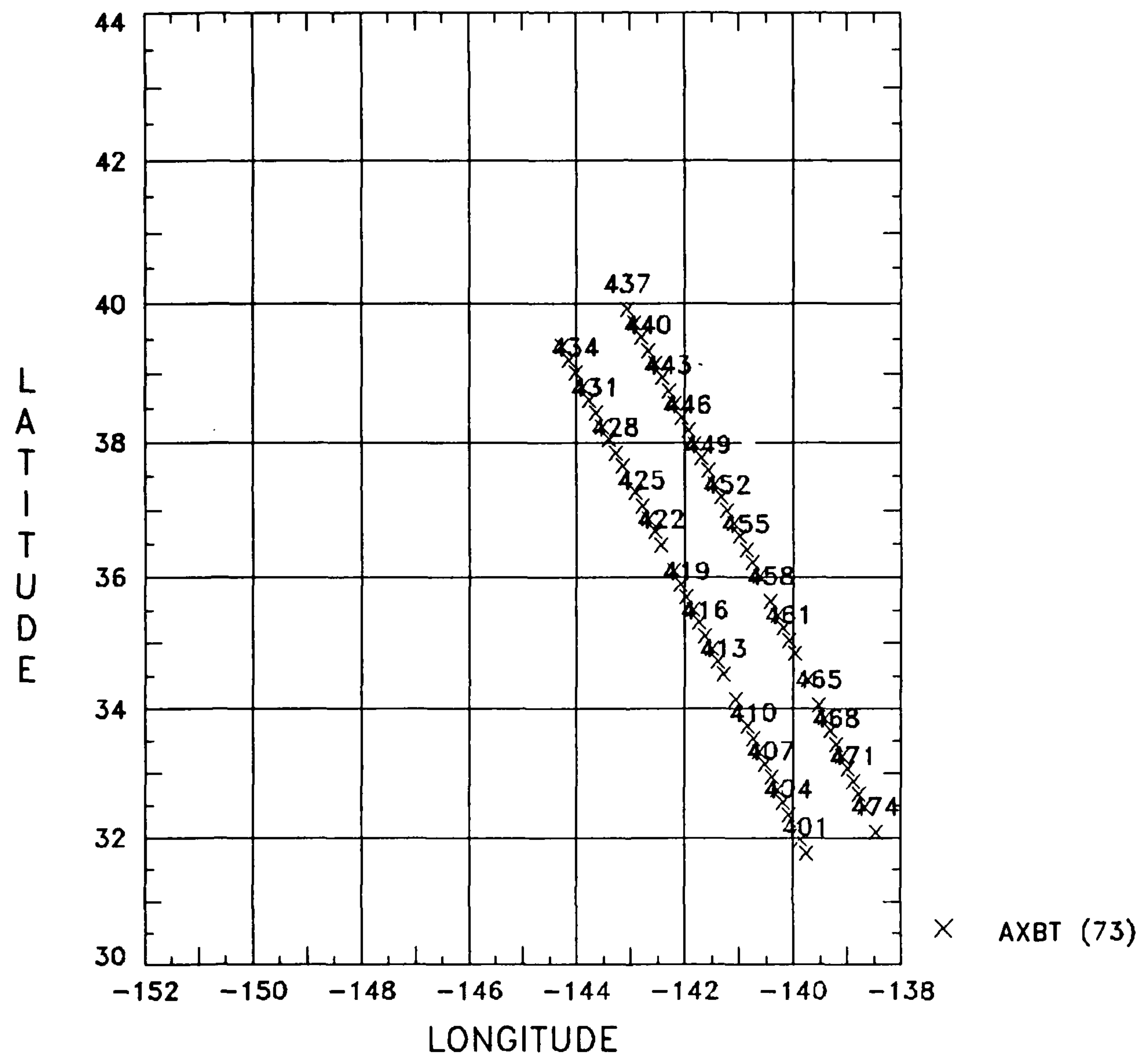
Temperature: Surface to 300 m and Surface to 5500 m

Inferred Salinity: Surface to 5500 m

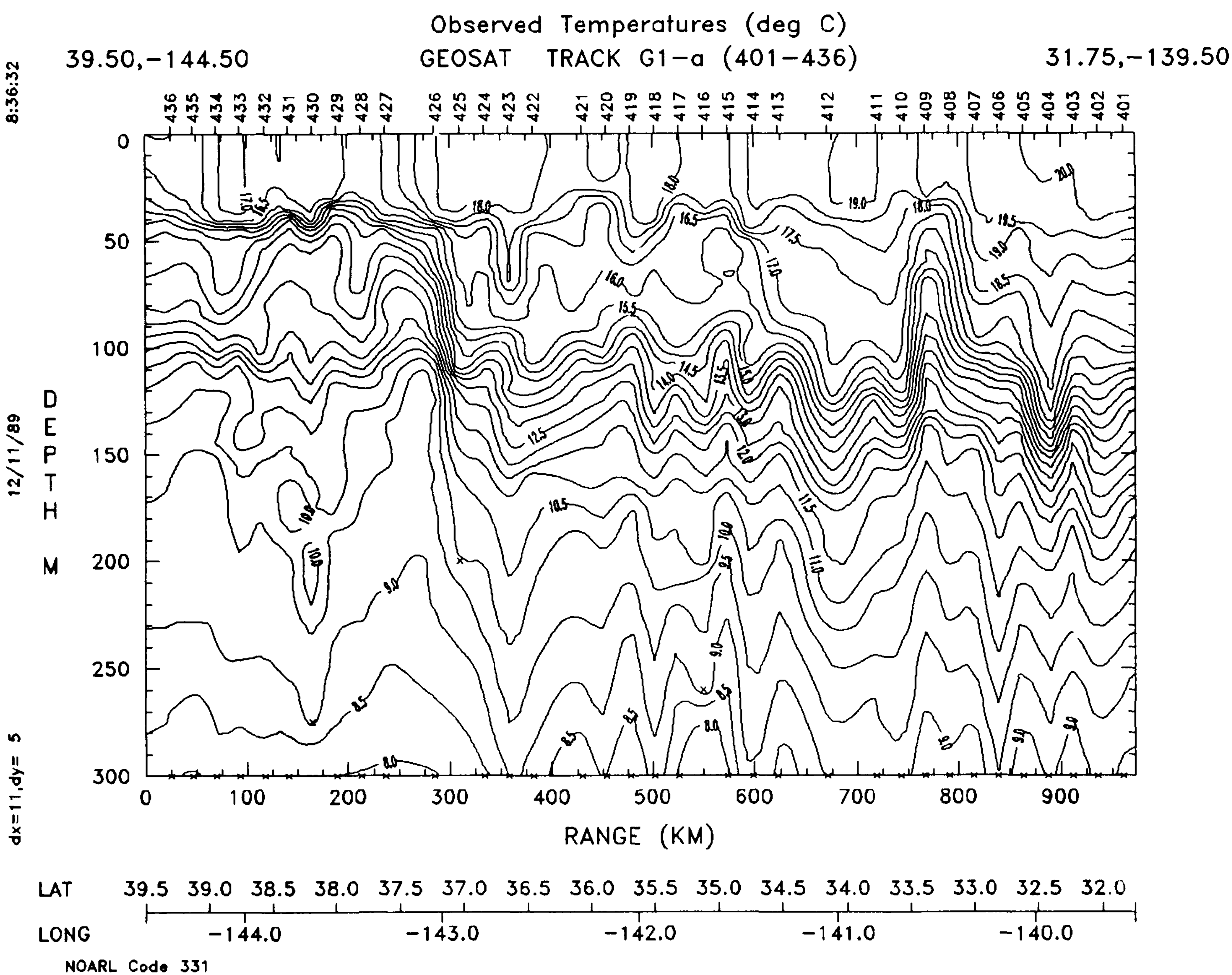
Calculated Sound Speed: Surface to 5500 m

GEOSAT #1 28 June 1989

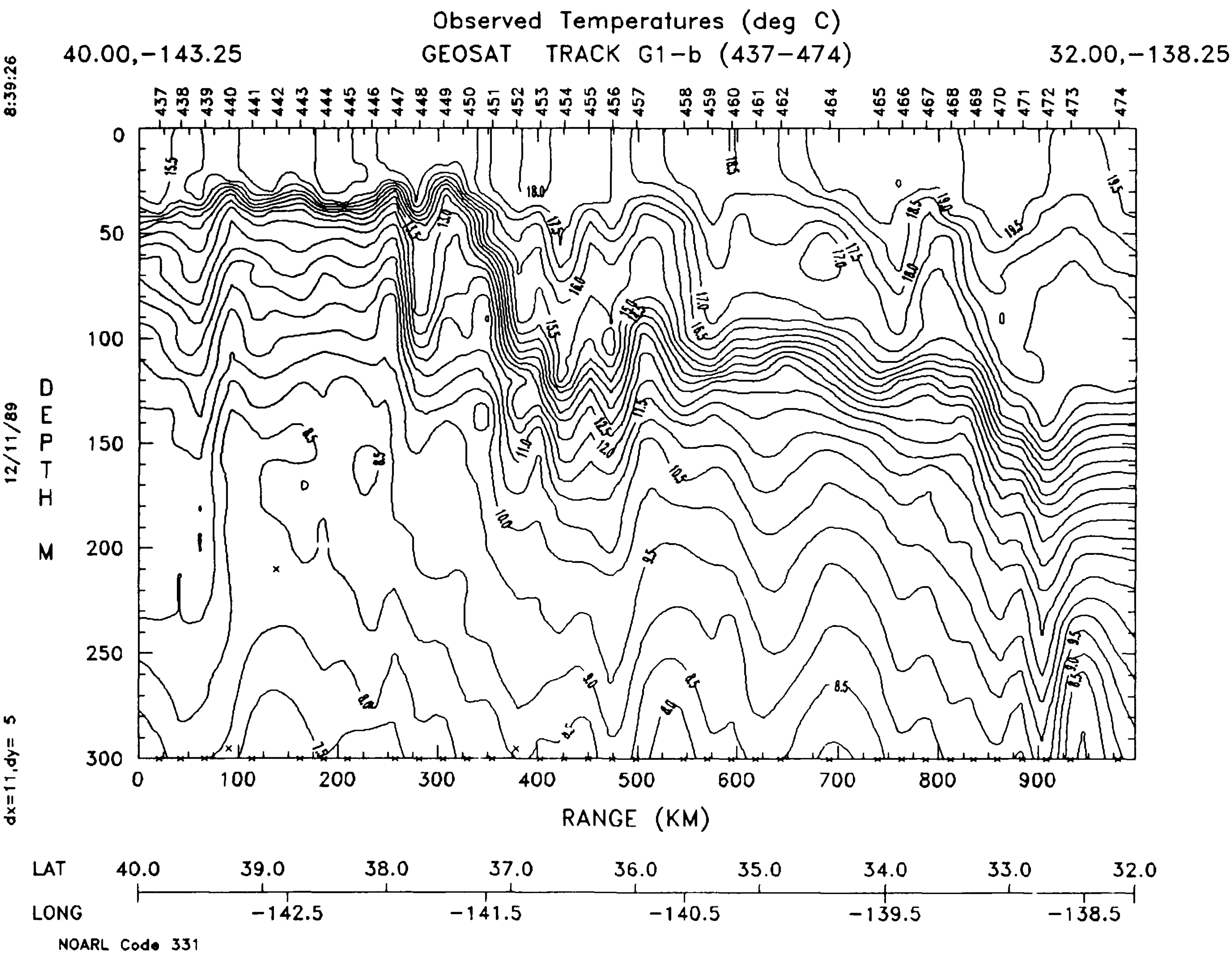
73 Probes



NOARL Code 331



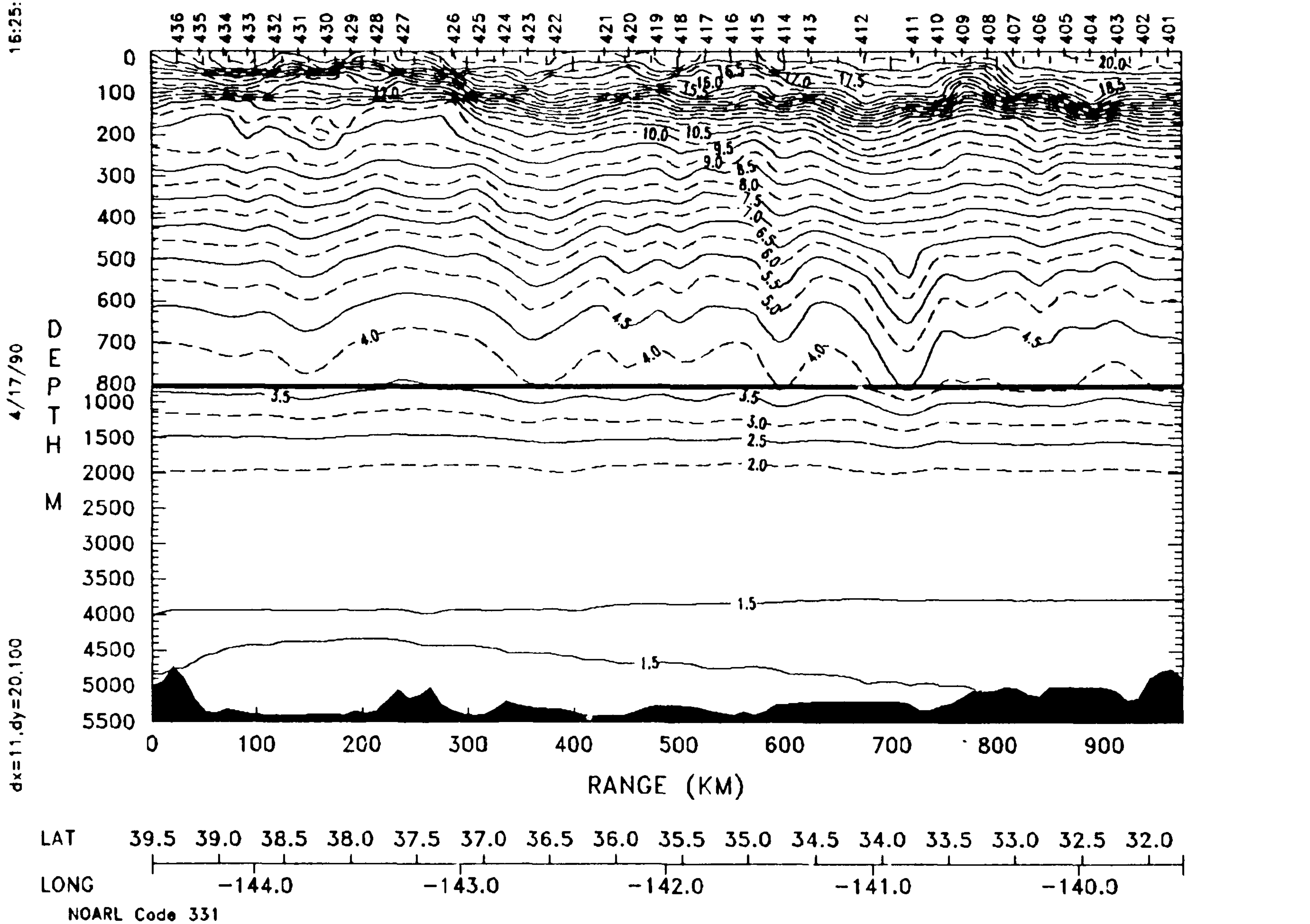
Observed Temperatures (deg C)
39.50,-144.50
GEOSAT TRACK G1-a (401-436)
31.75,-139.50
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331
8:36:32
12/11/89
dx=11,dy= 5

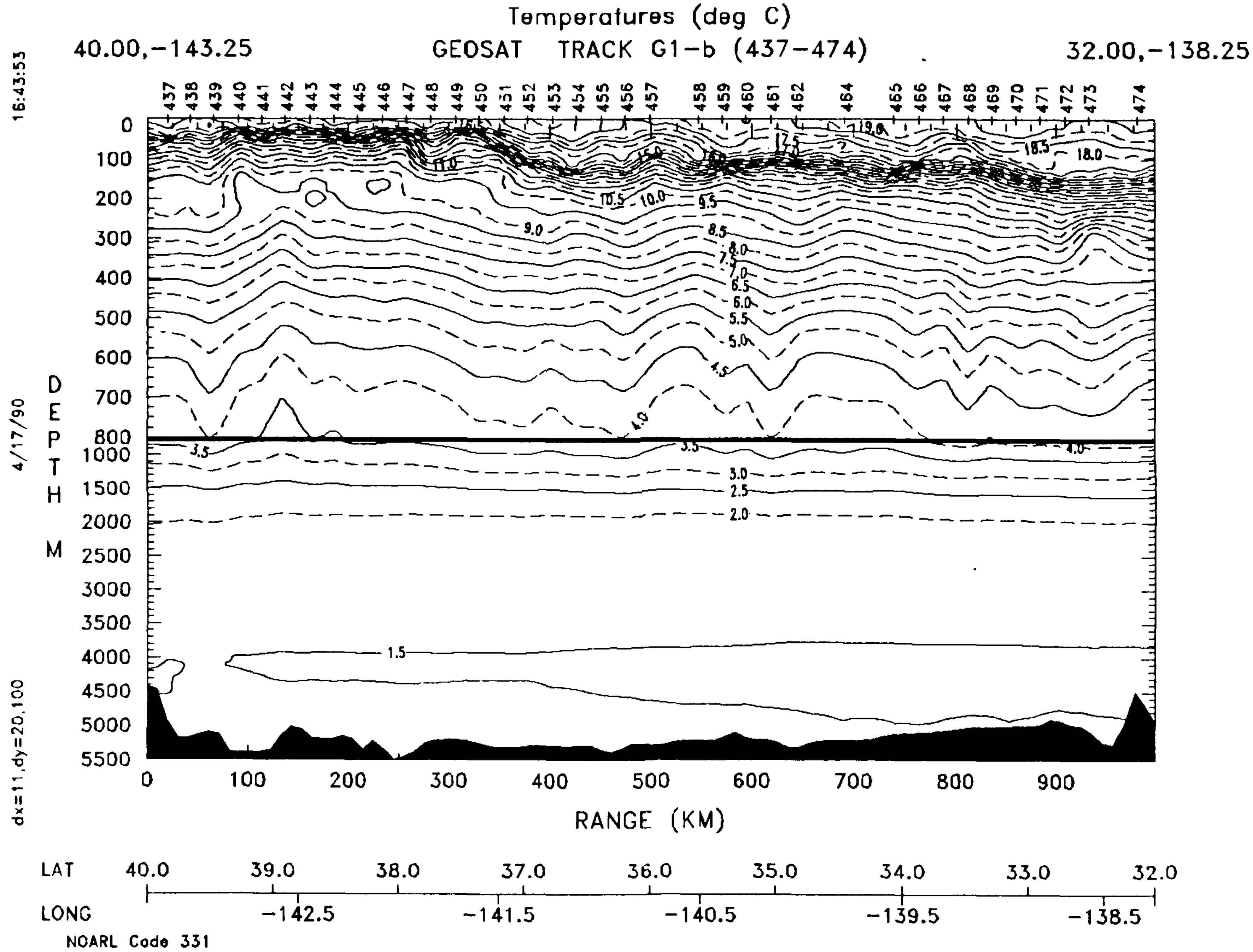


Observed Temperatures (deg C)
40.00,-143.25
GEOSAT TRACK G1-b (437-474)
32.00,-138.25
8:39:26
12/11/89
dx=11,dy= 5
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331

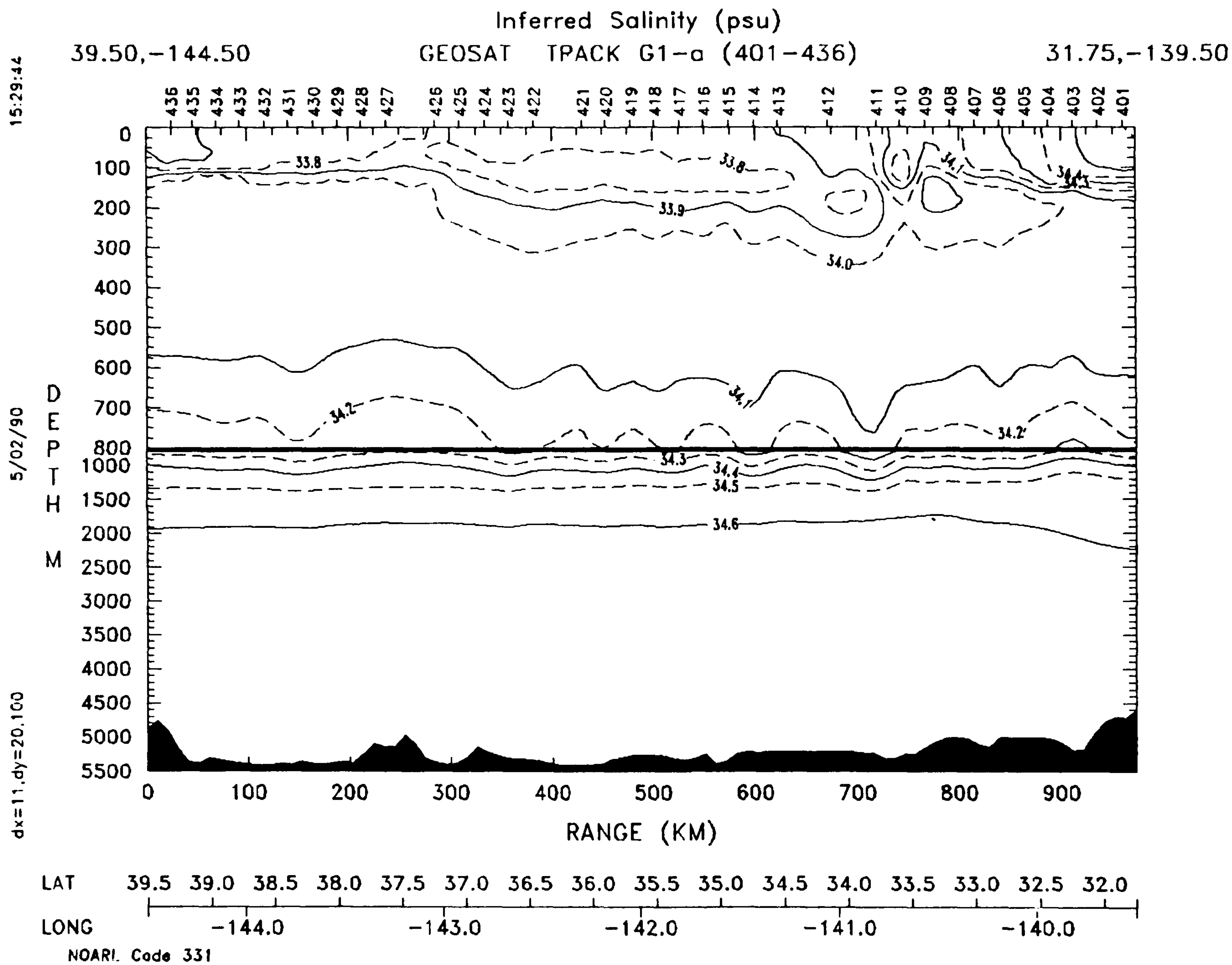
Temperatures (deg C)

39.50,-144.50 GEOSAT TRACK G1-a (401-436) 31.75,-139.50

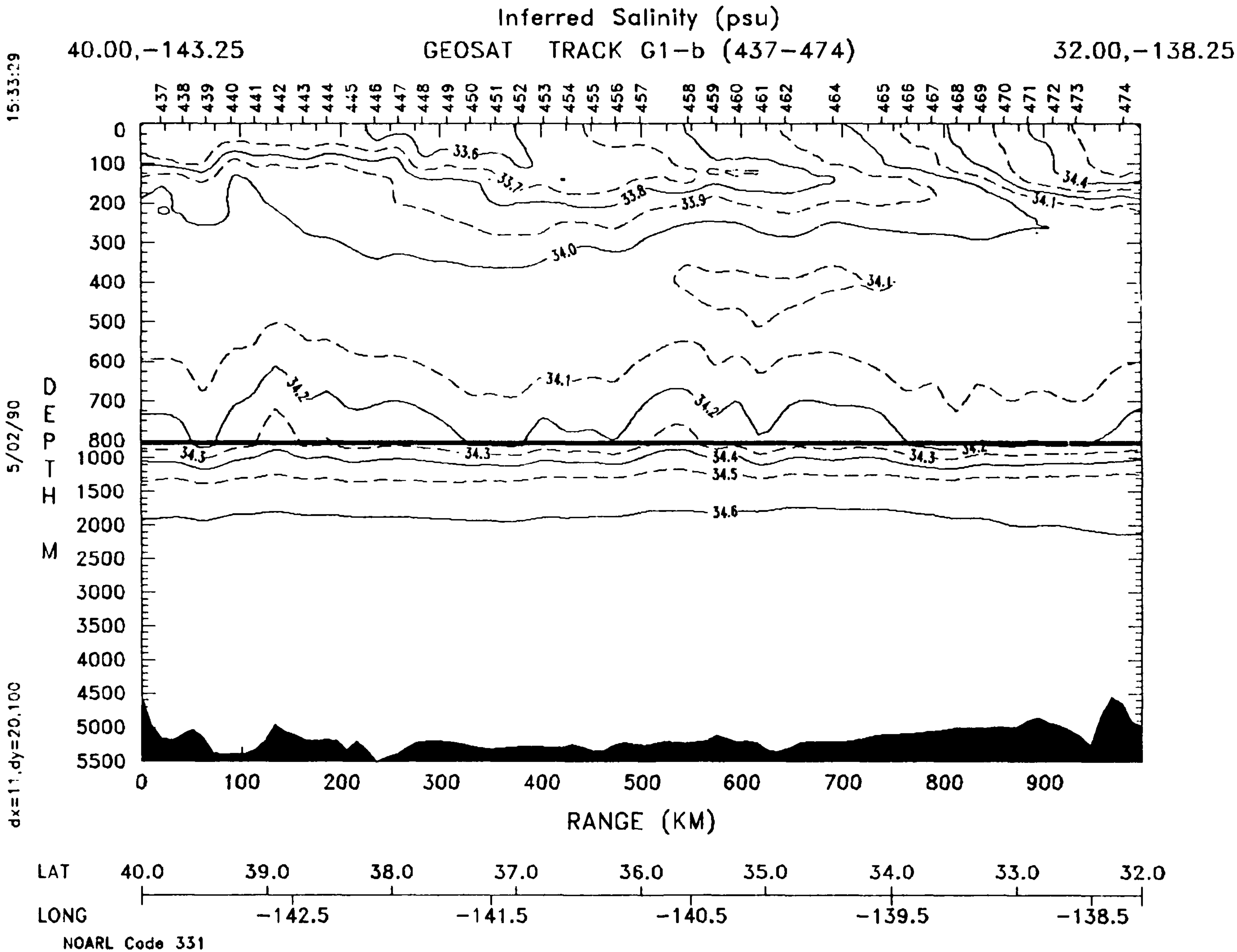


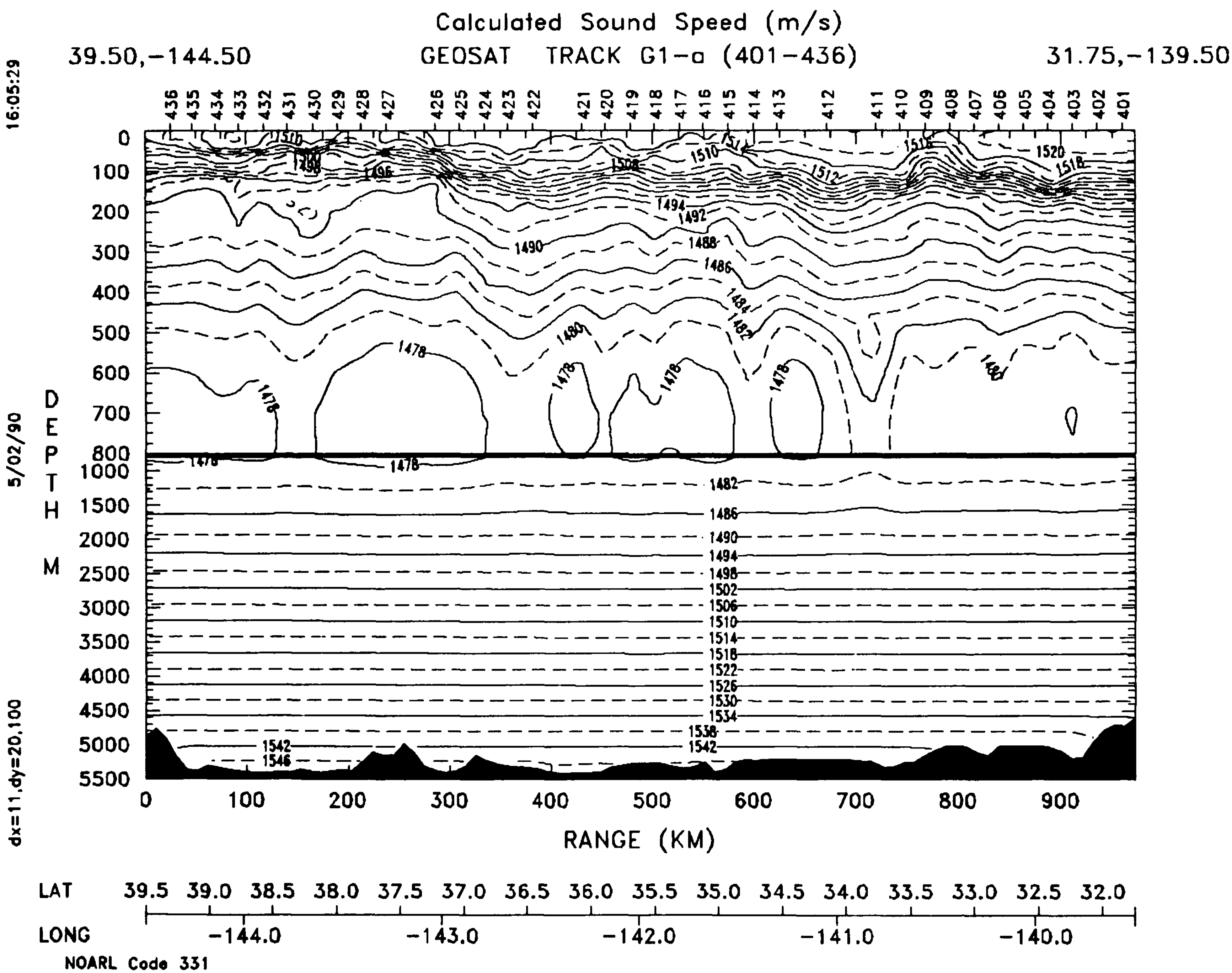


Temperatures (deg C)
40.00,-143.25
GEOSAT TRACK G1-b (437-474)
32.00,-138.25
16:43:53
4/17/90
dx=11,dy=20,100
437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 464 465 466 467 468 469 470 471 472 473 474
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
19.0
18.5
18.0
17.5
17.0
15.0
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
0 100 200 300 400 500 600 700 800 900
RANGE (KM)
LAT 40.0 39.0 38.0 37.0 36.0 35.0 34.0 33.0 32.0
LONG -142.5 -141.5 -140.5 -139.5 -138.5
NOARL Code 331

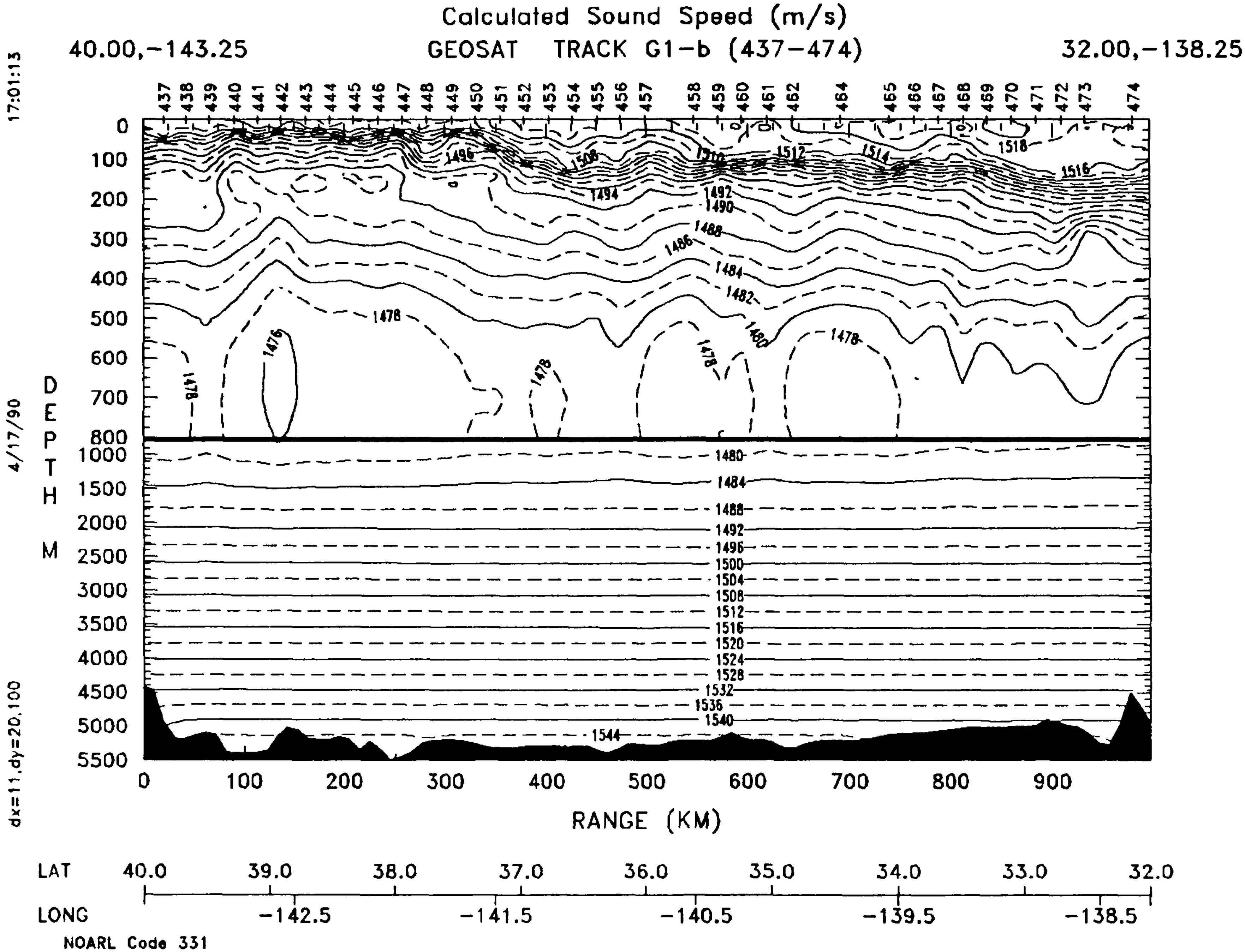


Inferred Salinity (psu)
39.50,-144.50
GEOSAT TRACK G1-a (401-436)
31.75,-139.50
15:29:44
5/02/90
dx=11,dy=20,100
436 435 434 433 432 431 430 429 428 427 426 425 424 423 422 421 420 419 418 417 416 415 414 413 412 411 410 409 408 407 406 405 404 403 402 401
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
0 100 200 300 400 500 600 700 800 900
RANGE (KM)
LAT 39.5 39.0 38.5 38.0 37.5 37.0 36.5 36.0 35.5 35.0 34.5 34.0 33.5 33.0 32.5 32.0
LONG -144.0 -143.0 -142.0 -141.0 -140.0
NOARL Code 331


Inferred Salinity (psu)
40.00,-143.25
GEOSAT TRACK G1-b (437-474)
32.00,-138.25
437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 464 465 466 467 468 469 470 471 472 473 474
33.6
33.7
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
0 100 200 300 400 500 600 700 800 900
RANGE (KM)
LAT 40.0 39.0 38.0 37.0 36.0 35.0 34.0 33.0 32.0
LONG -142.5 -141.5 -140.5 -139.5 -138.5
NOARL Code 331
15:33:29
5/02/90
dx=11,dy=20,100



Calculated Sound Speed (m/s)
39.50,-144.50
GEOSAT TRACK G1-a (401-436)
31.75,-139.50
16:05:29
5/02/90
dx=11,dy=20,100
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331


Calculated Sound Speed (m/s)
40.00,-143.25
GEOSAT TRACK G1-b (437-474)
32.00,-138.25
17:01:13
4/17/90
dx=11,dy=20,100
437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 464 465 466 467 468 469 470 471 472 473 474
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
1496 1508 1510 1512 1514 1518 1516 1494 1492 1490 1488 1486 1484 1482 1480 1478 1476
1480 1484 1488 1492 1496 1500 1504 1508 1512 1516 1520 1524 1528 1532 1536 1540 1544
0 100 200 300 400 500 600 700 800 900
RANGE (KM)
LAT 40.0 39.0 38.0 37.0 36.0 35.0 34.0 33.0 32.0
LONG -142.5 -141.5 -140.5 -139.5 -138.5
NOARL Code 331

Appendix O.

Second GEOSAT Underflight, 30 June 1989

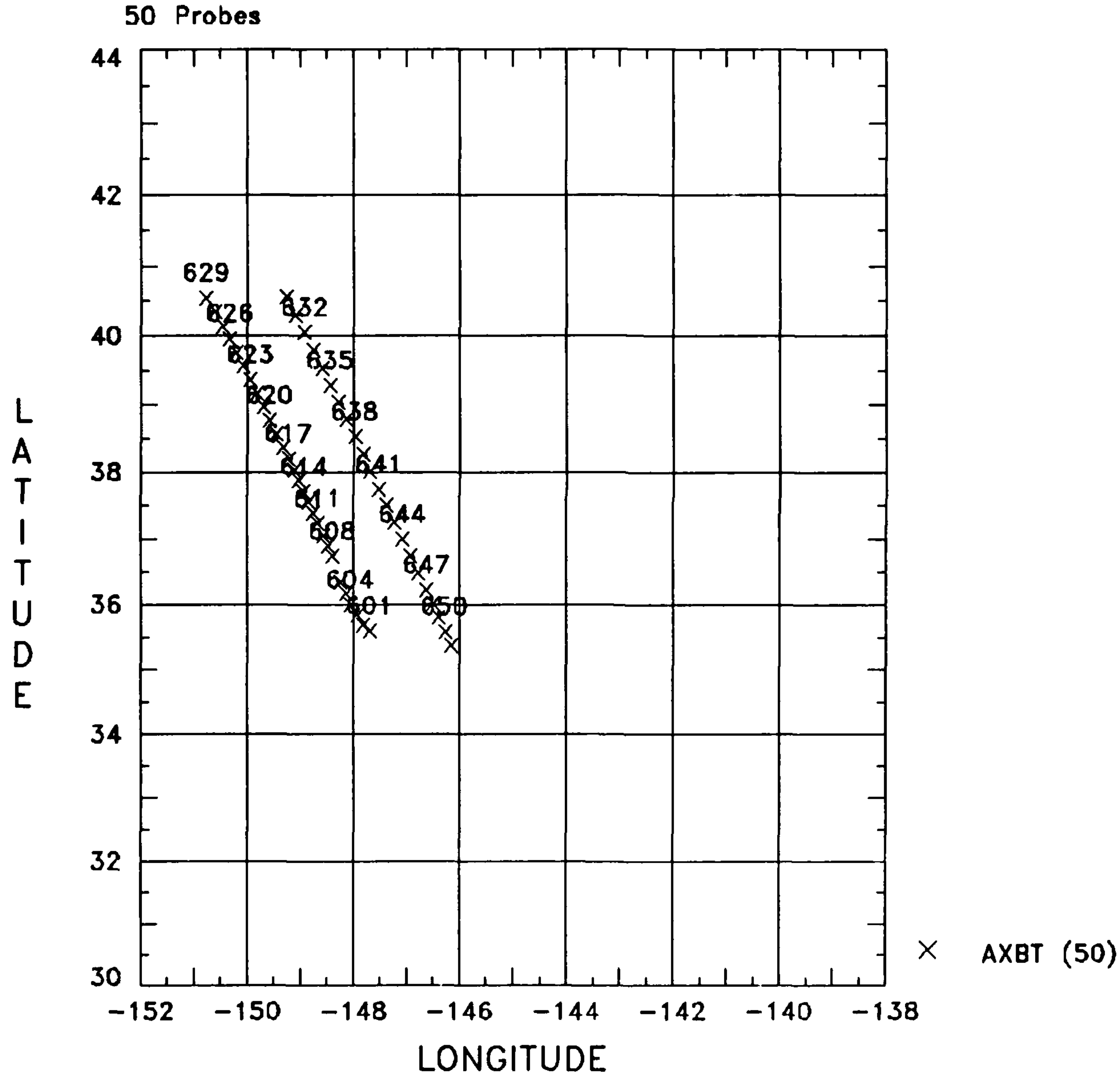
Vertical Contours

Temperature: Surface to 300 m and Surface to 5500 m

Inferred Salinity: Surface to 5500 m

Calculated Sound Speed: Surface to 5500 m

GEOSAT #2   30 June 1989



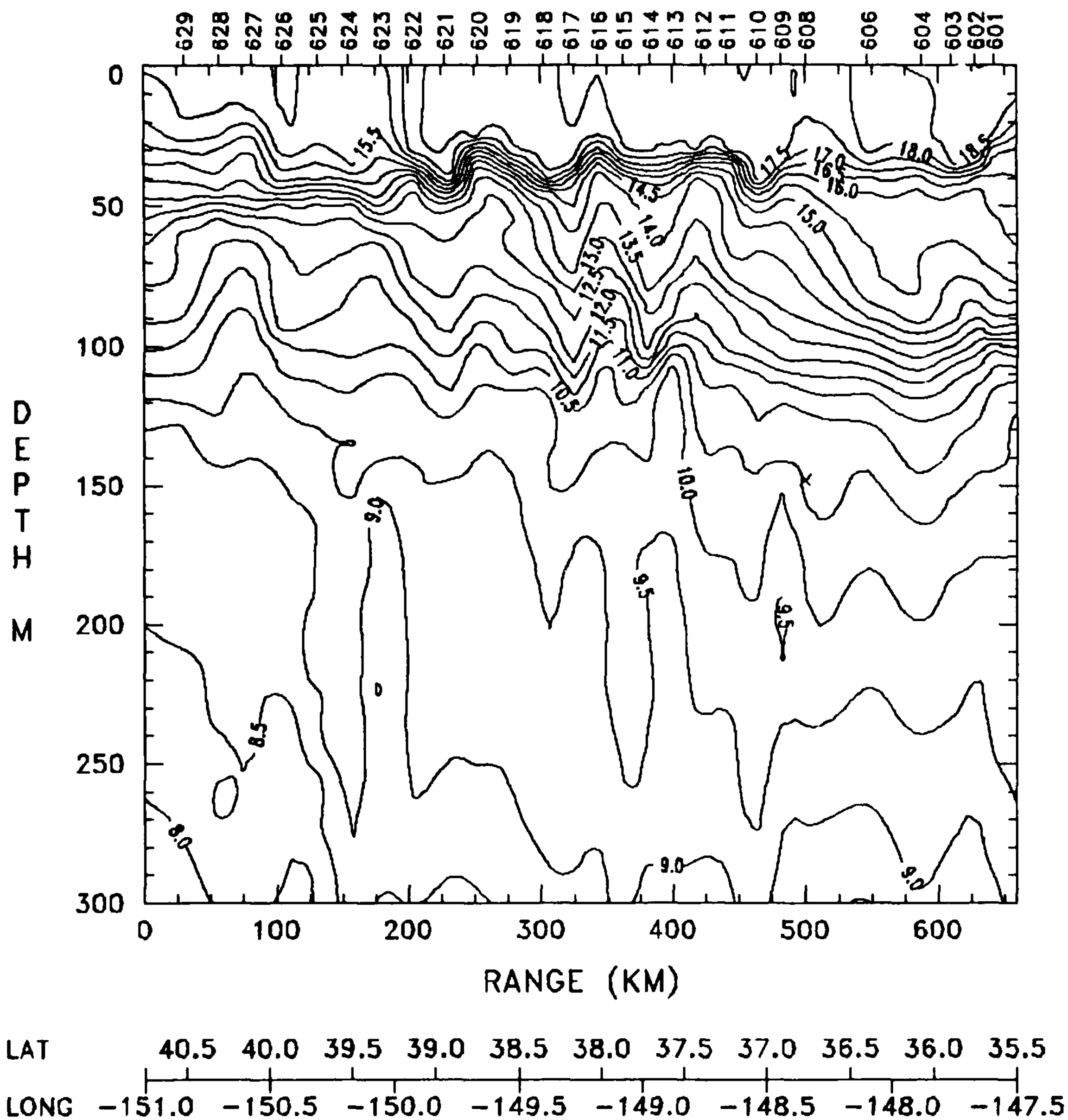
NOARL Code 331

4/17/90

8:22:44

Observed Temperatures (deg C)

40.75,−151.00 GEOSAT TRACK G2−a (601−629) 35.50,−147.50

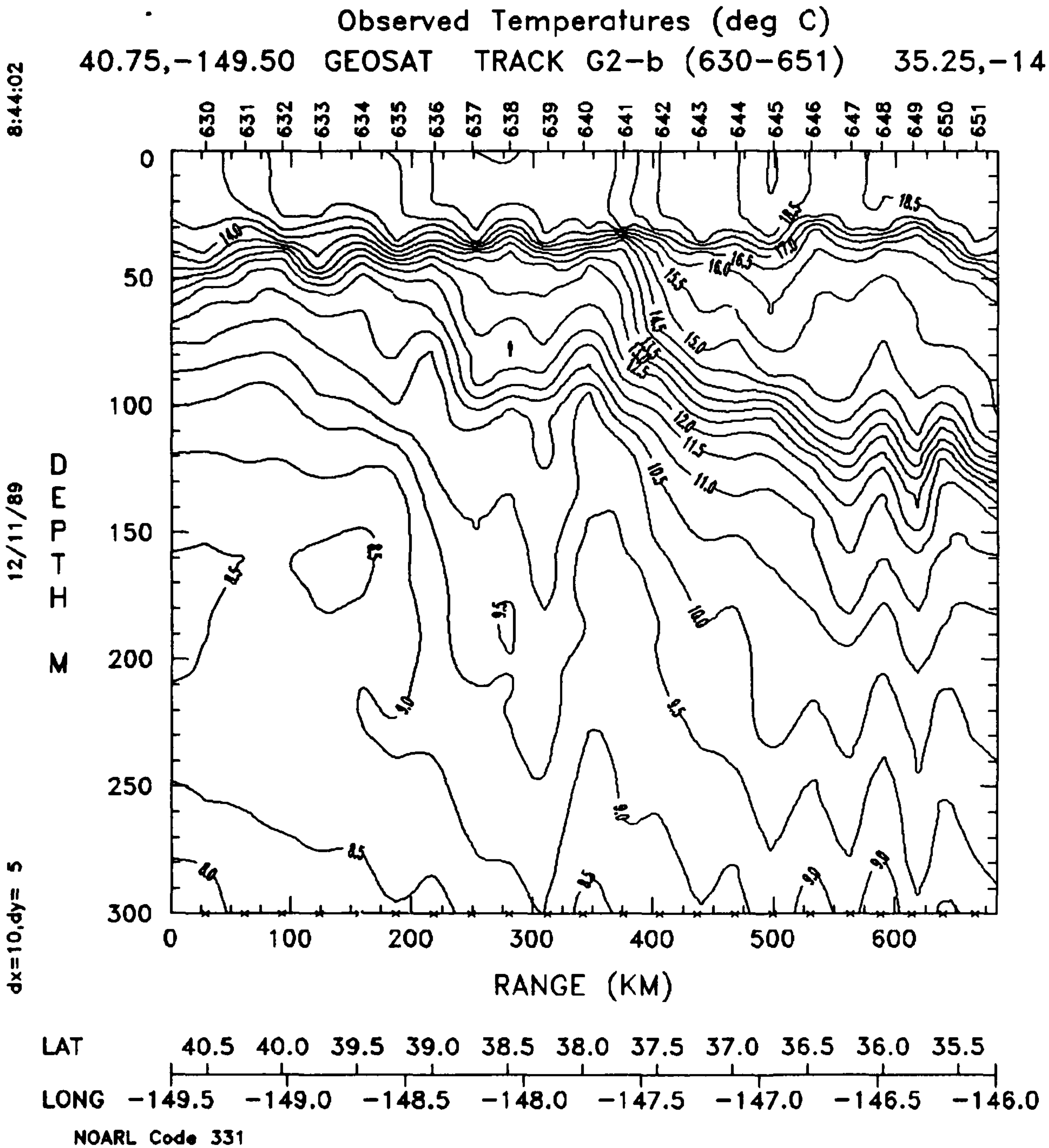


NOARL Code 331

11:08:33

5/17/90

dx=10,dy= 5



Observed Temperatures (deg C)
40.75,-149.50 GEOSAT TRACK G2-b (630-651) 35.25,-146.00
630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651
DEPTH M
0 50 100 150 200 250 300
RANGE (KM)
0 100 200 300 400 500 600
LAT 40.5 40.0 39.5 39.0 38.5 38.0 37.5 37.0 36.5 36.0 35.5
LONG -149.5 -149.0 -148.5 -148.0 -147.5 -147.0 -146.5 -146.0
NOARL Code 331
8:44:02
12/11/89
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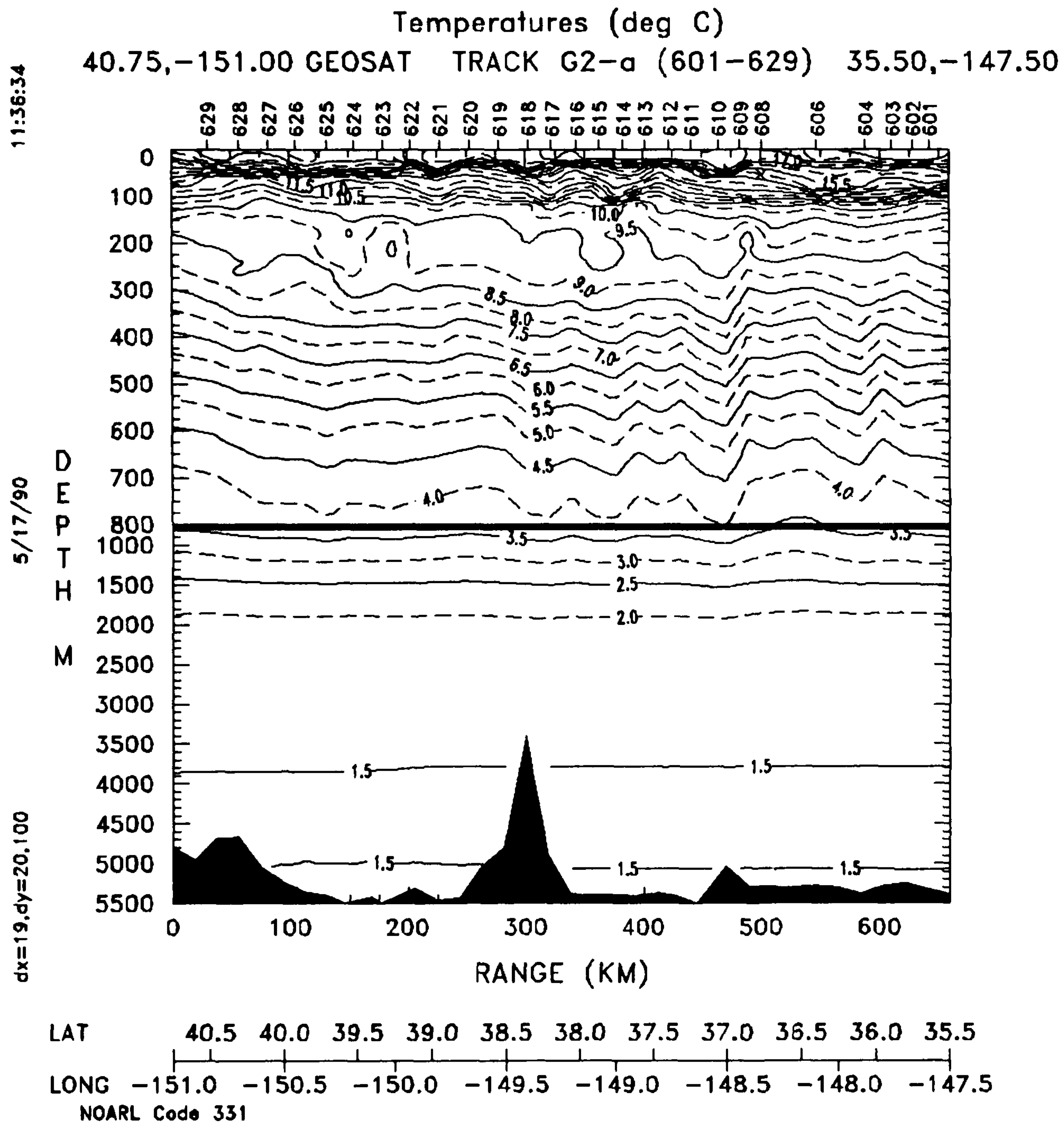
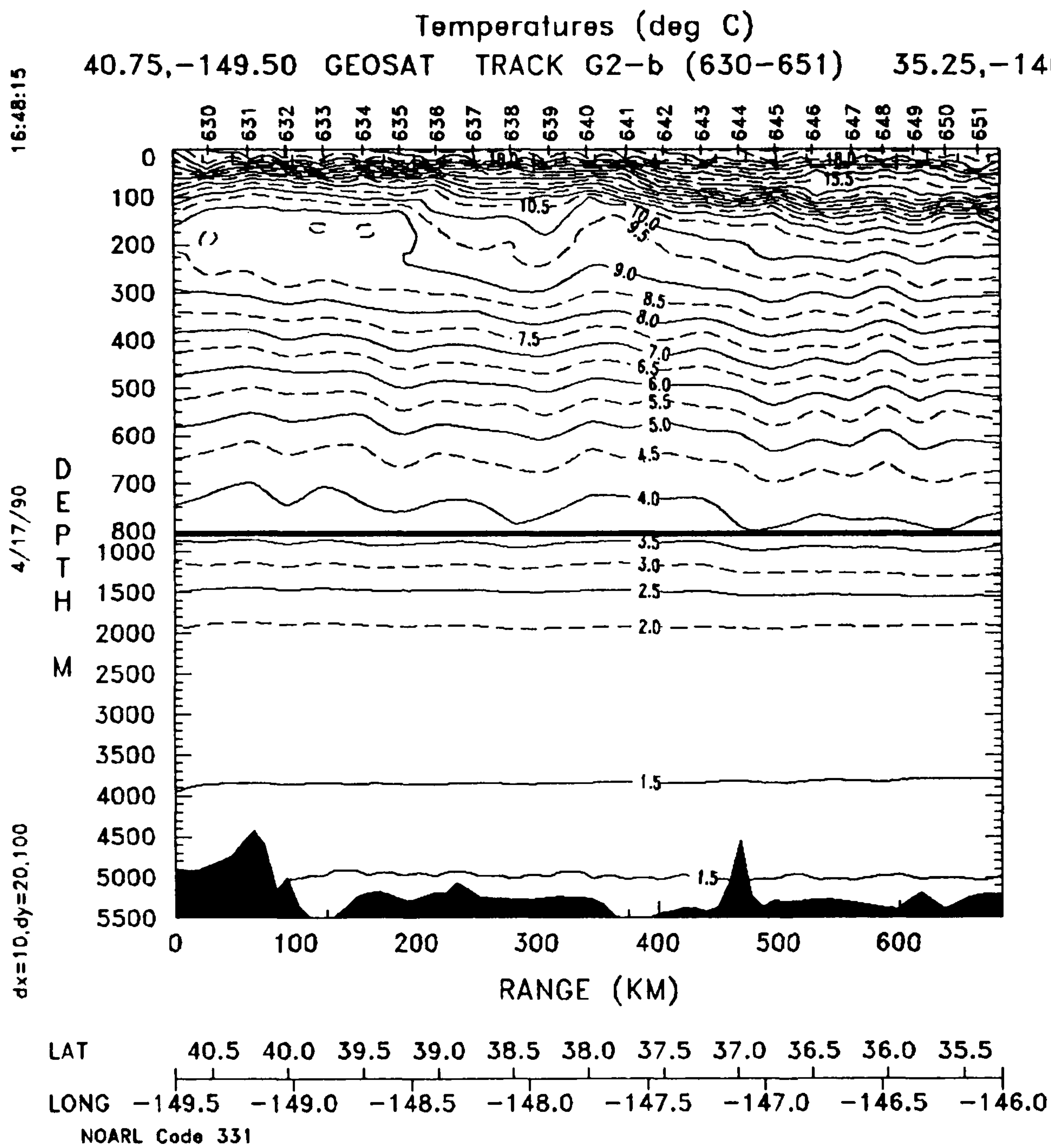
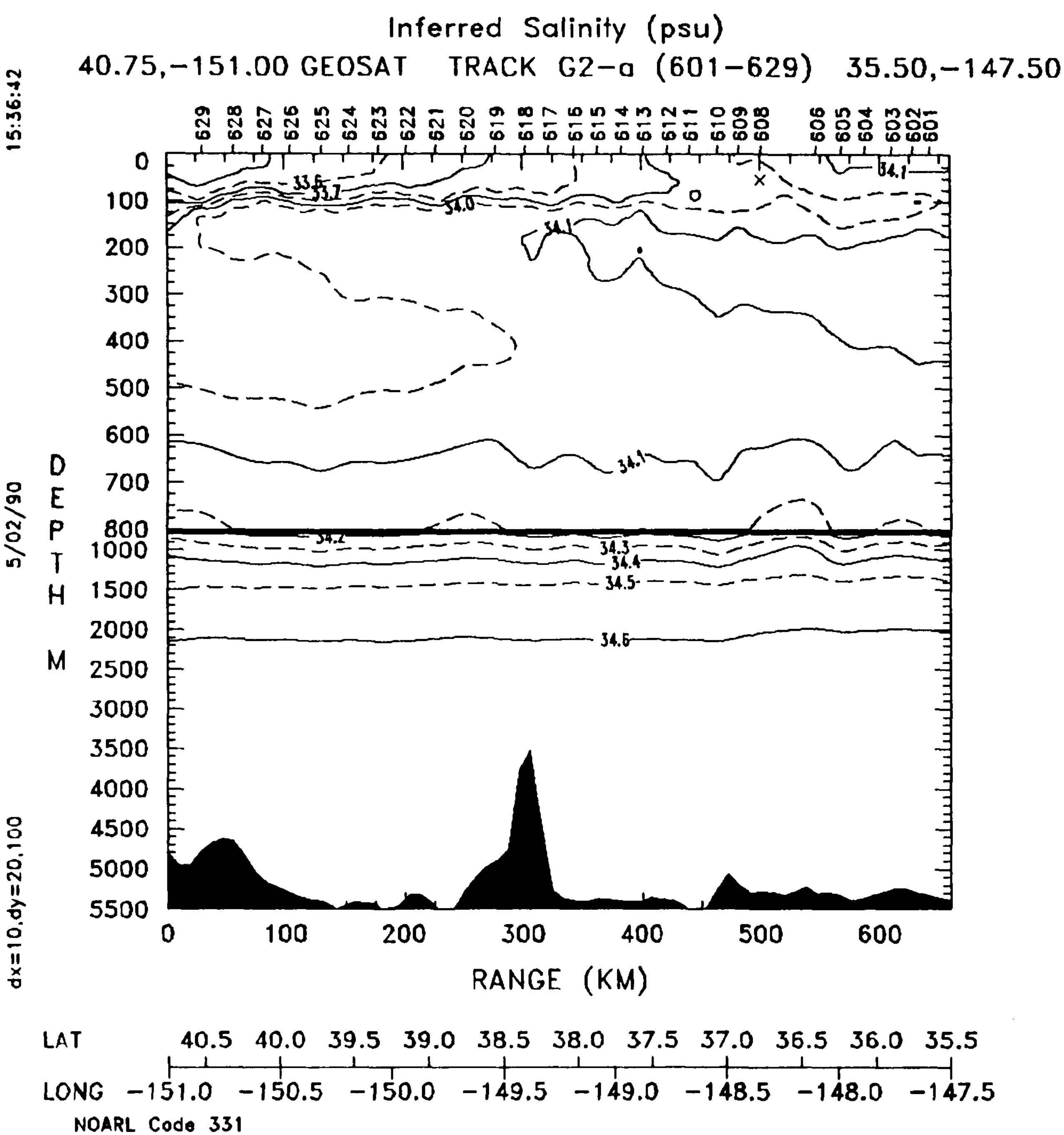


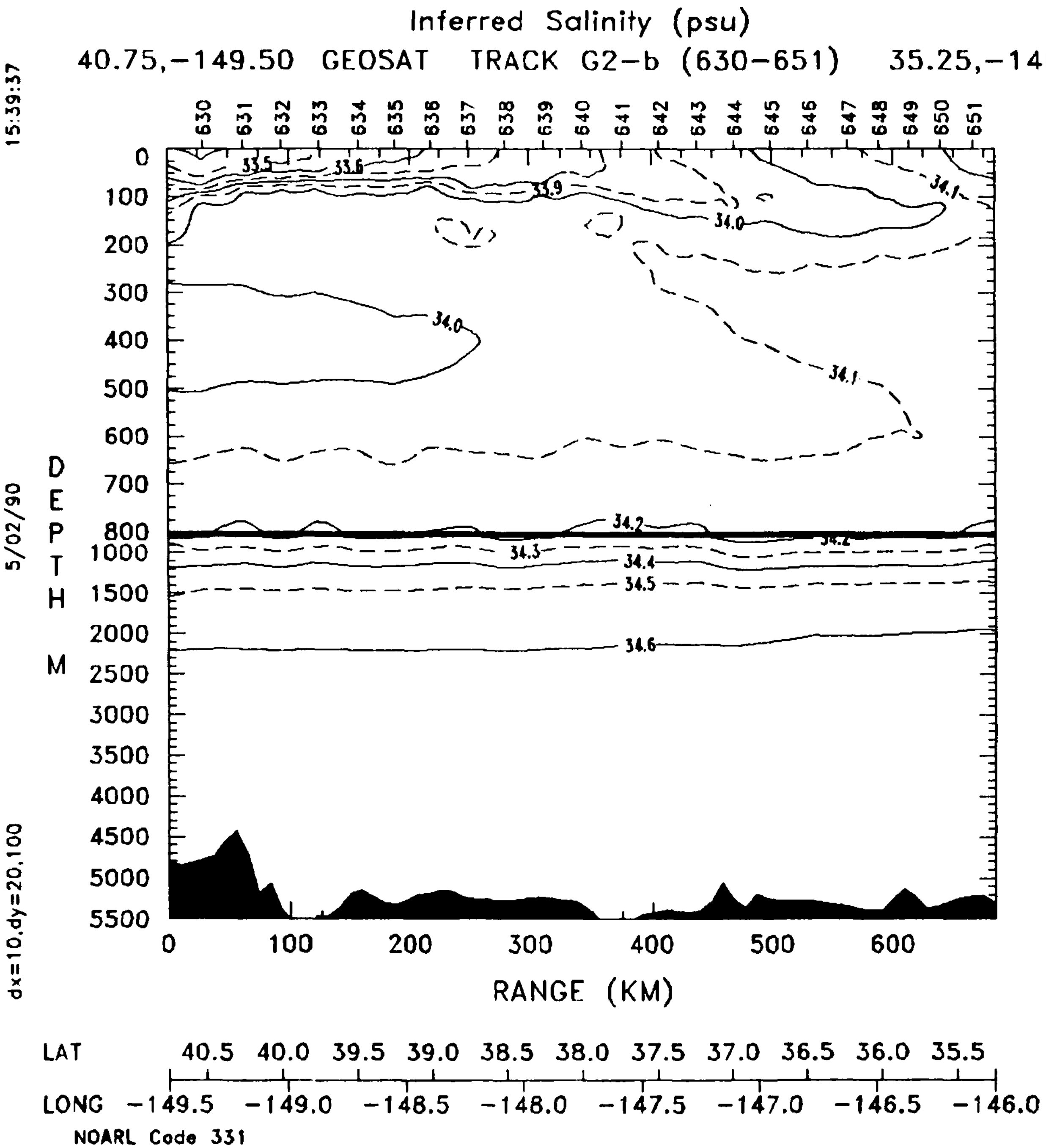
11:36:34
Temperatures (deg C)
40.75,-151.00 GEOSAT TRACK G2-a (601-629) 35.50,-147.50
629 628 627 626 625 624 623 622 621 620 619 618 617 616 615 614 613 612 611 610 609 608 606 604 603 602 601
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
5/17/90
dx=19,dy=20,100
0 100 200 300 400 500 600
RANGE (KM)
LAT 40.5 40.0 39.5 39.0 38.5 38.0 37.5 37.0 36.5 36.0 35.5
LONG -151.0 -150.5 -150.0 -149.5 -149.0 -148.5 -148.0 -147.5
NOARL Code 331



Temperatures (deg C)
40.75,-149.50 GEOSAT TRACK G2-b (630-651) 35.25,-146.00
16:48:15
4/17/90
dx=10,dy=20,100
630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5
0 100 200 300 400 500 600
RANGE (KM)
LAT 40.5 40.0 39.5 39.0 38.5 38.0 37.5 37.0 36.5 36.0 35.5
LONG -149.5 -149.0 -148.5 -148.0 -147.5 -147.0 -146.5 -146.0
NOARL Code 331



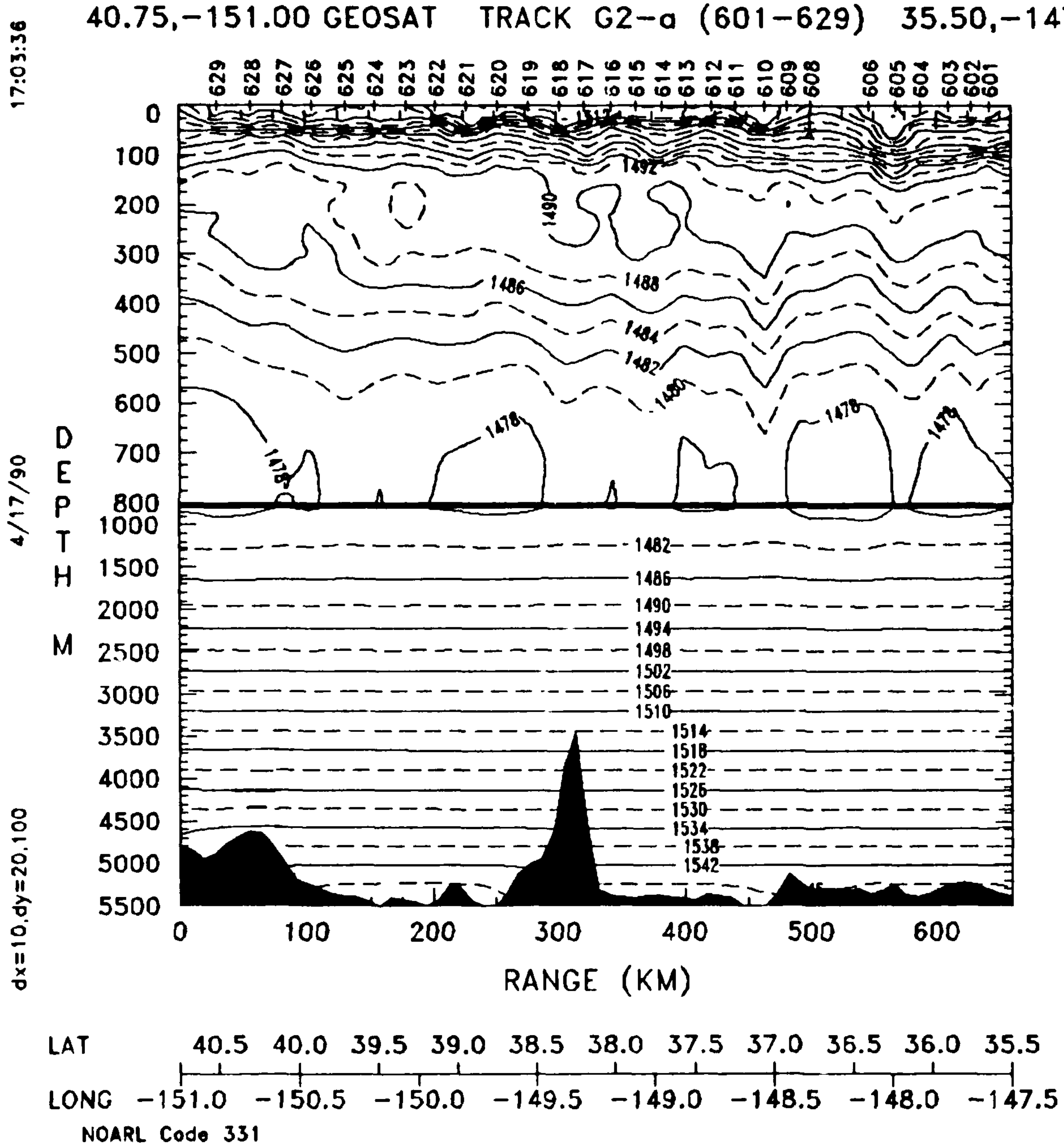
Inferred Salinity (psu)
40.75,-151.00 GEOSAT TRACK G2-a (601-629) 35.50,-147.50
15:36:42
5/02/90
dx=10,dy=20,100
629 628 627 626 625 624 623 622 621 620 619 618 617 616 615 614 613 612 611 610 609 608 606 605 604 603 602 601
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
33.6
33.7
34.0
34.1
34.2
34.3
34.4
34.5
34.6
0 100 200 300 400 500 600
RANGE (KM)
LAT 40.5 40.0 39.5 39.0 38.5 38.0 37.5 37.0 36.5 36.0 35.5
LONG -151.0 -150.5 -150.0 -149.5 -149.0 -148.5 -148.0 -147.5
NOARL Code 331

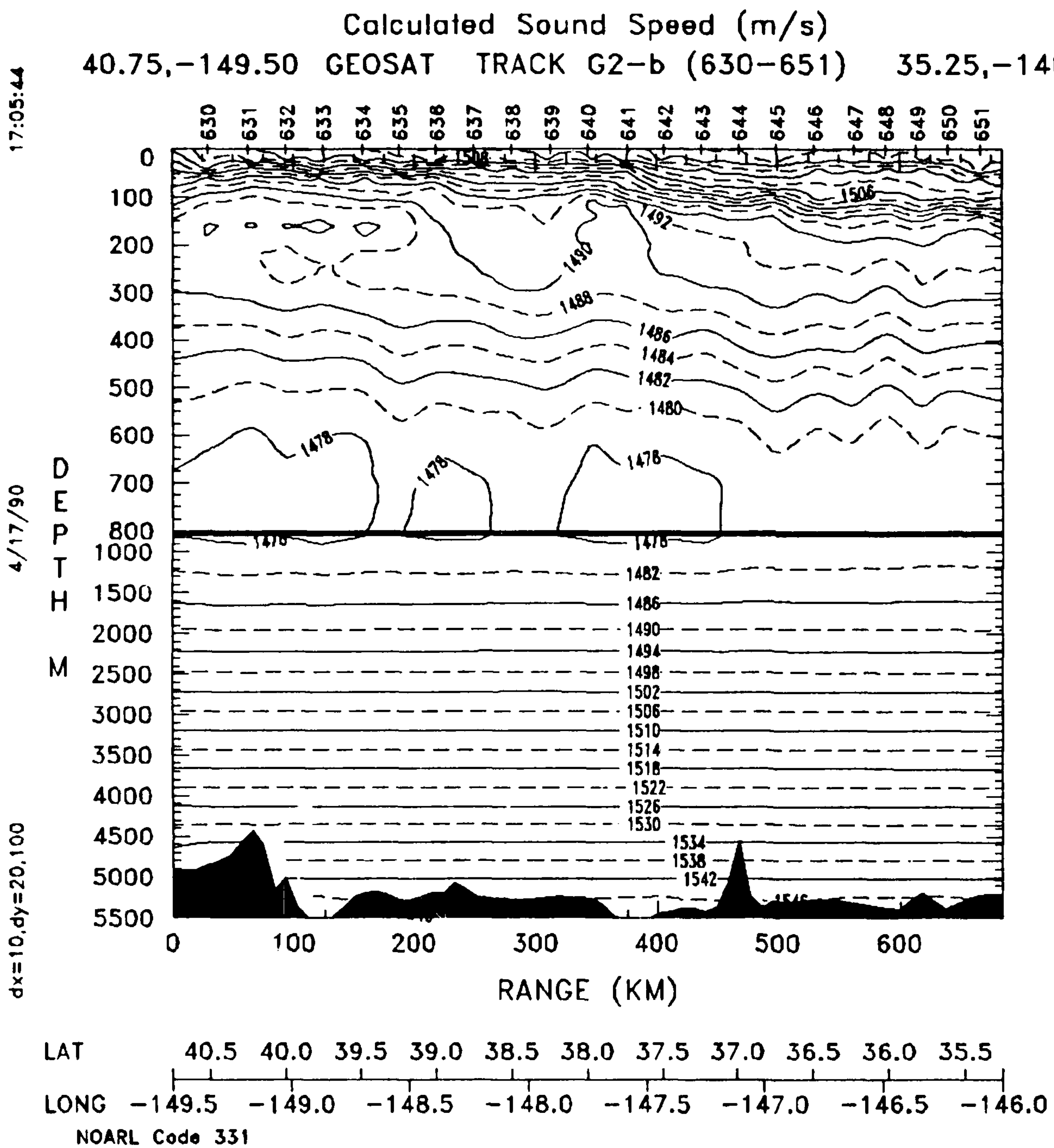


Inferred Salinity (psu)
40.75,-149.50 GEOSAT TRACK G2-b (630-651) 35.25,-146.00
15:39:37
5/02/90
dx=10,dy=20,100
630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
33.5
33.6
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
0 100 200 300 400 500 600
RANGE (KM)
LAT 40.5 40.0 39.5 39.0 38.5 38.0 37.5 37.0 36.5 36.0 35.5
LONG -149.5 -149.0 -148.5 -148.0 -147.5 -147.0 -146.5 -146.0
NOARL Code 331

Calculated Sound Speed (m/s)

40.75,-151.00 GEOSAT TRACK G2-a (601-629) 35.50,-147.50




17:05:44
Calculated Sound Speed (m/s)
40.75,-149.50 GEOSAT TRACK G2-b (630-651) 35.25,-146.00
630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651
1506
1492
1490
1488
1486
1484
1482
1480
1478
1478
1478
1478
1482
1486
1490
1494
1498
1502
1506
1510
1514
1518
1522
1526
1530
1534
1538
1542
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
4/17/90
dx=10,dy=20,100
0 100 200 300 400 500 600
RANGE (KM)
LAT 40.5 40.0 39.5 39.0 38.5 38.0 37.5 37.0 36.5 36.0 35.5
LONG -149.5 -149.0 -148.5 -148.0 -147.5 -147.0 -146.5 -146.0
NOARL Code 331

Appendix P

Third GEOSAT Underflight, 11 July 1989

Vertical Contours

Temperature: Surface to 300 m and Surface to 5500 m

Inferred Salinity: Surface to 5500 m

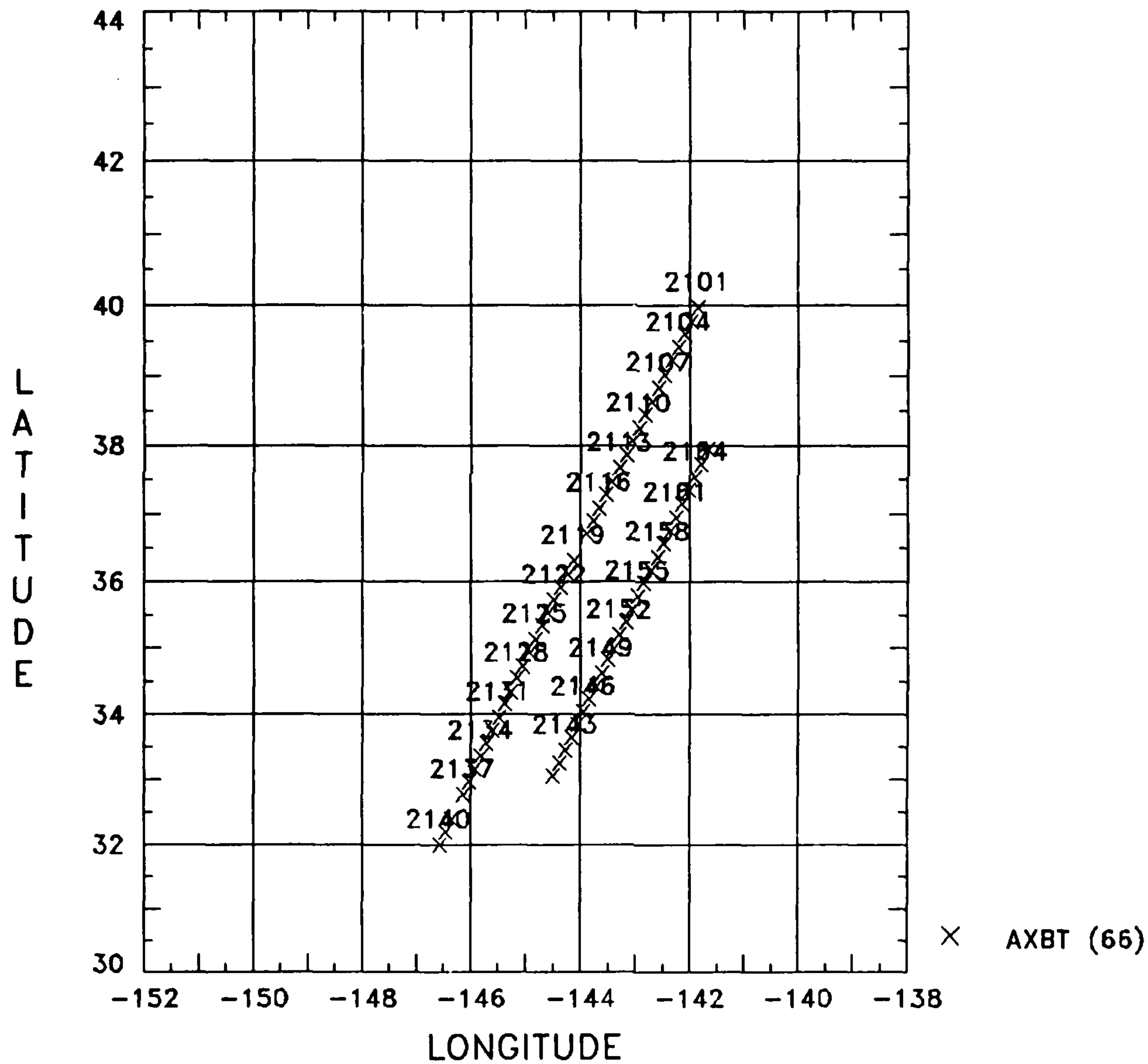
Calculated Sound Speed: Surface to 5500 m

8:25:06

4/17/90

GEOSAT #3   11 July 1989

66 Probes



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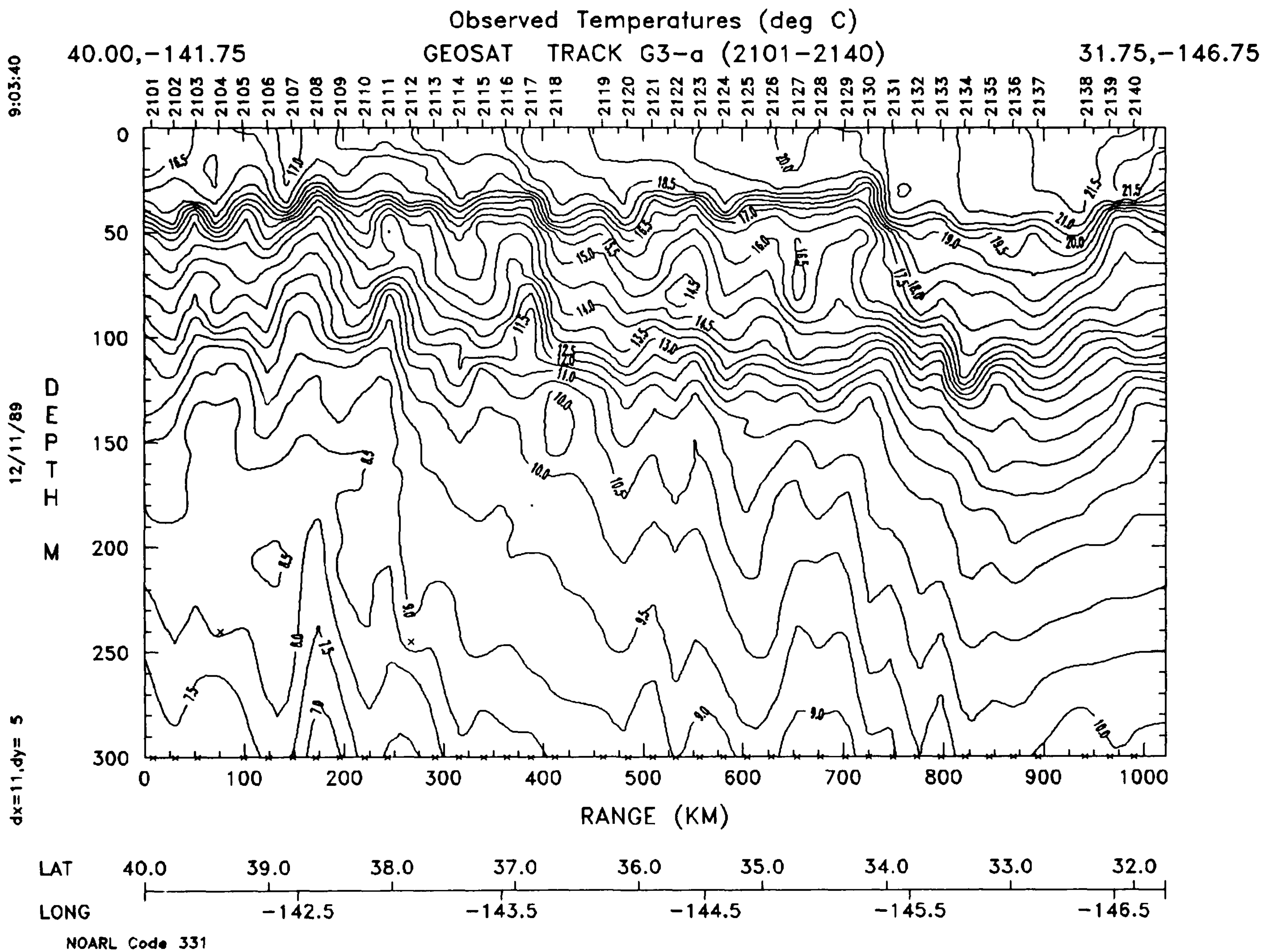
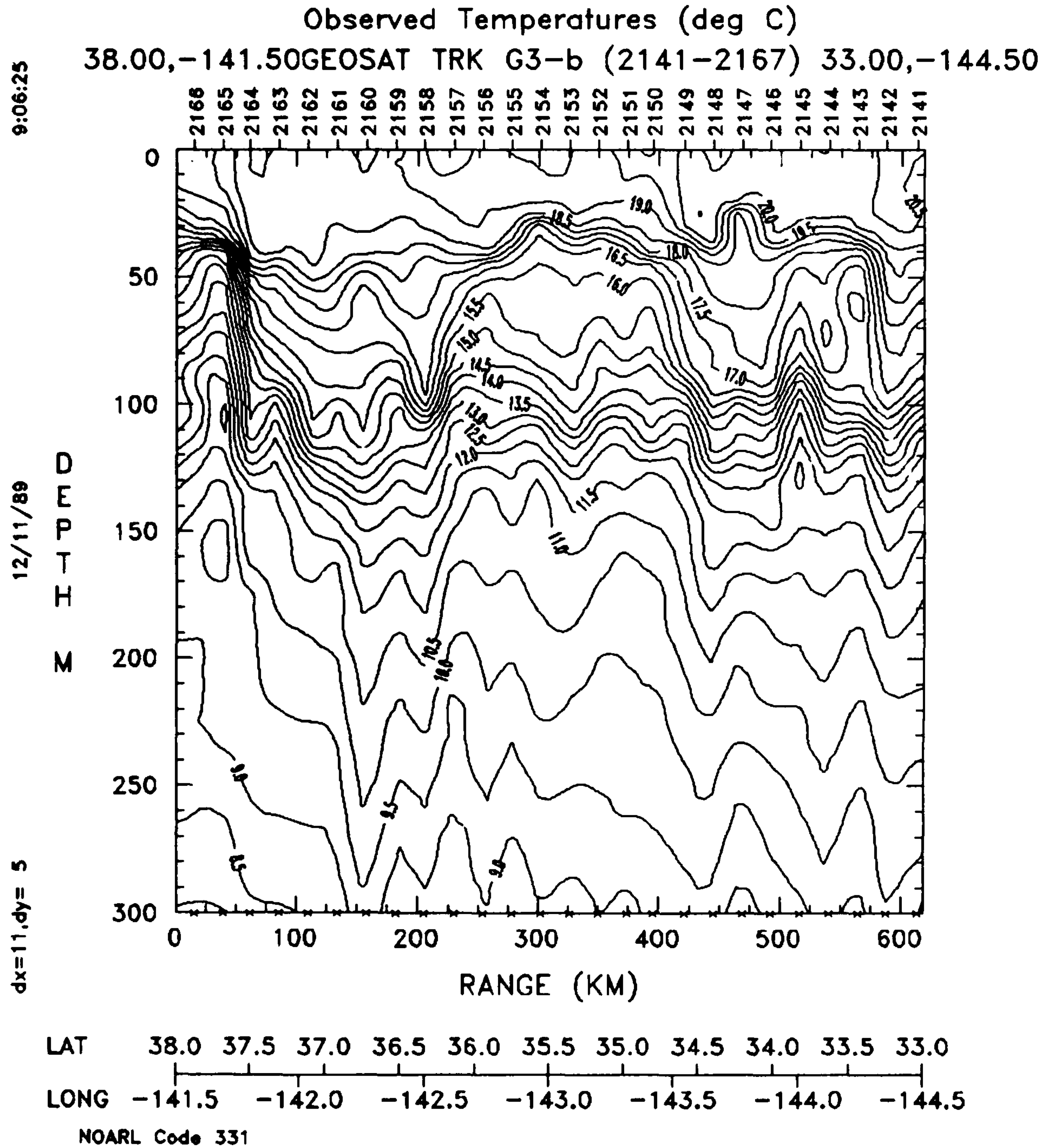
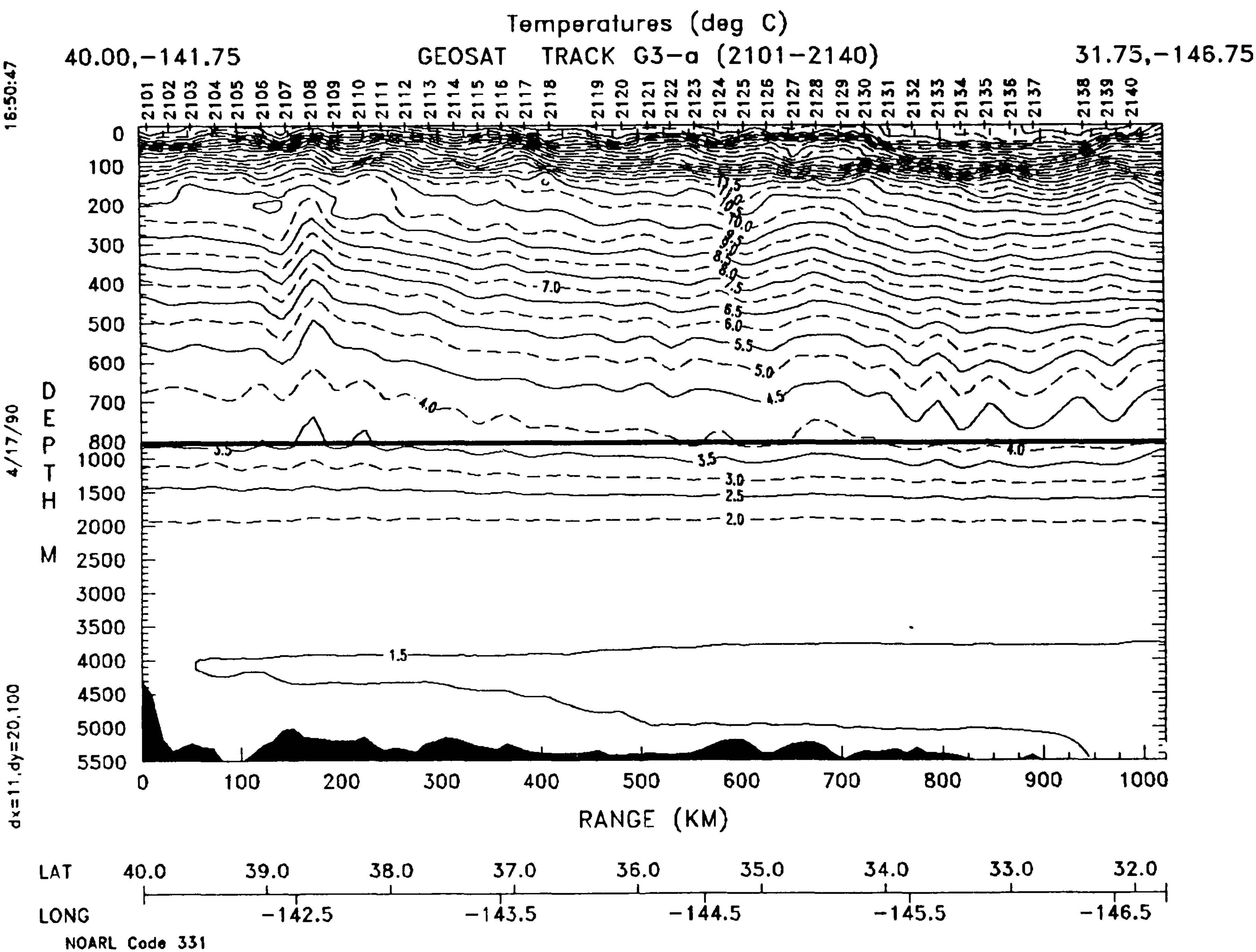


Observed Temperatures (deg C)
GEOSAT TRACK G3-a (2101-2140)
40.00,-141.75
31.75,-146.75
9:03:40
12/11/89
dx=11,dy= 5
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331



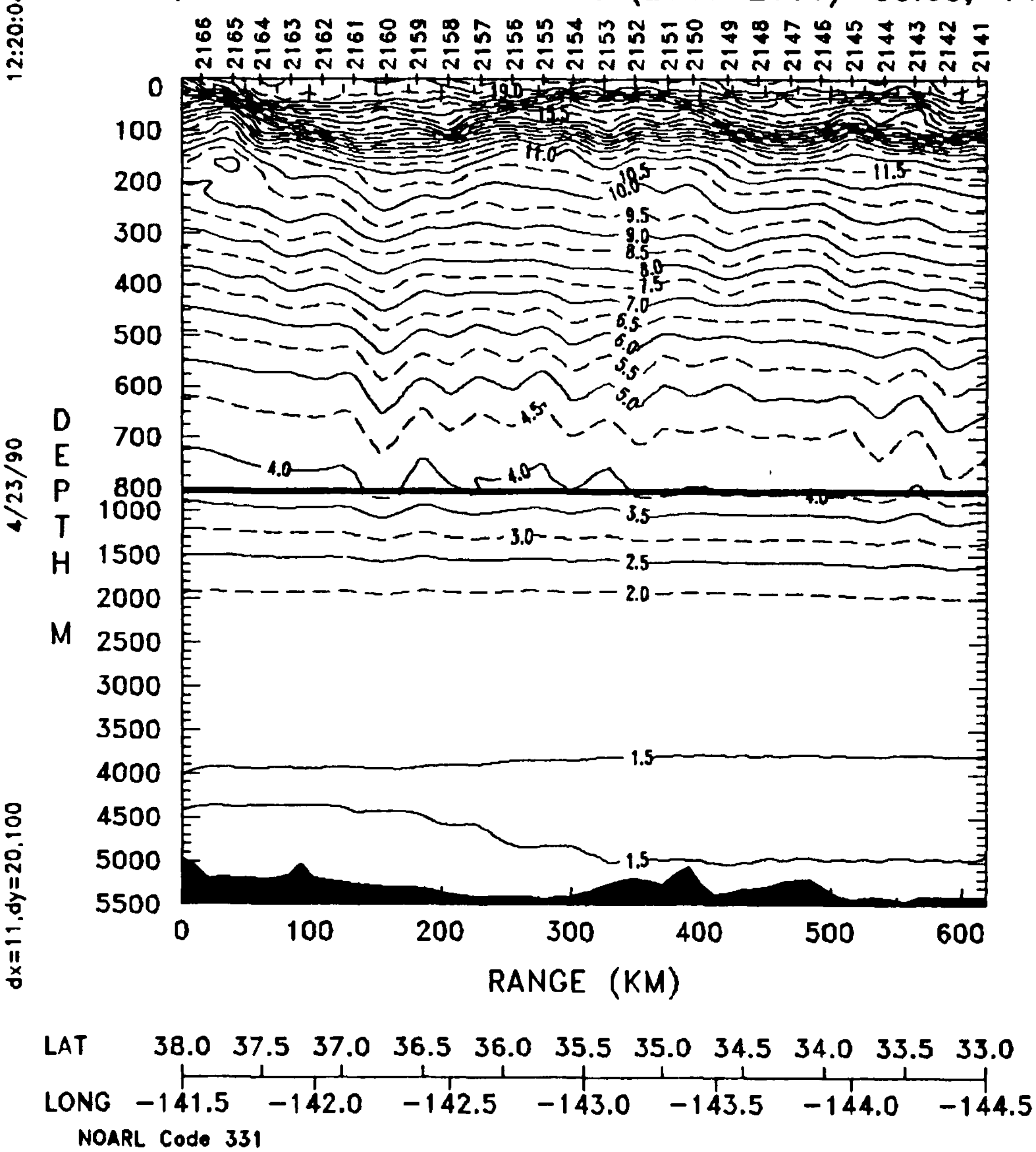
Observed Temperatures (deg C)
38.00,-141.50GEOSAT TRK G3-b (2141-2167) 33.00,-144.50
9:06:25
12/11/89
dx=11,dy= 5
2168 2165 2164 2163 2162 2161 2160 2159 2158 2157 2156 2155 2154 2153 2152 2151 2150 2149 2148 2147 2146 2145 2144 2143 2142 2141
DEPTH M
0 50 100 150 200 250 300
0 100 200 300 400 500 600
RANGE (KM)
LAT 38.0 37.5 37.0 36.5 36.0 35.5 35.0 34.5 34.0 33.5 33.0
LONG -141.5 -142.0 -142.5 -143.0 -143.5 -144.0 -144.5
NOARL Code 331

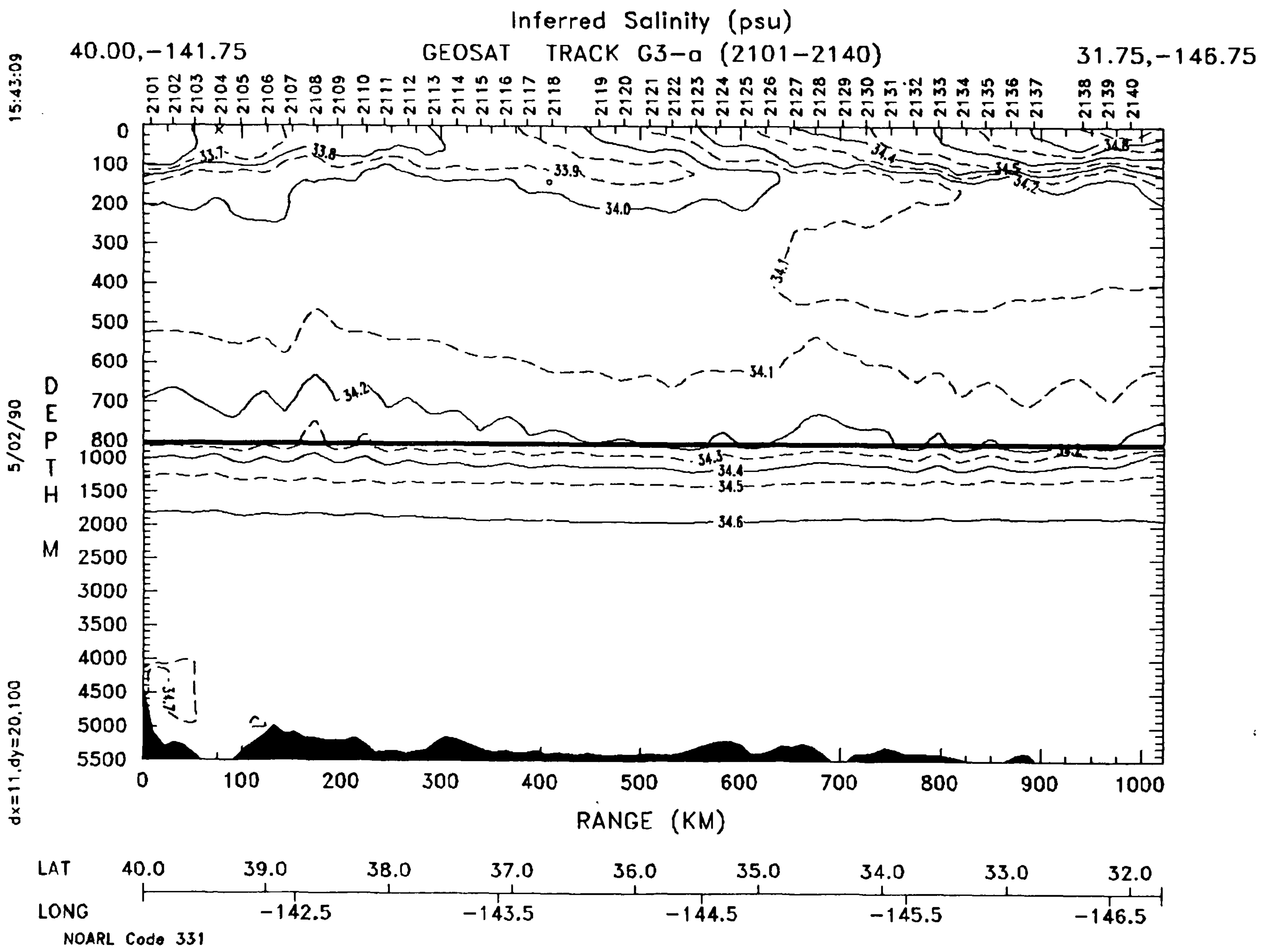


Temperatures (deg C)
40.00,-141.75
GEOSAT TRACK G3-a (2101-2140)
31.75,-146.75
16:50:47
4/17/90
dx=11,dy=20,100
2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5
0 100 200 300 400 500 600 700 800 900 1000
RANGE (KM)
LAT 40.0 39.0 38.0 37.0 36.0 35.0 34.0 33.0 32.0
LONG -142.5 -143.5 -144.5 -145.5 -146.5
NOARL Code 331

Temperatures (deg C)

38.00,-141.50 GEOSAT TR G3-b (2141-2166) 33.00,-144.50





Inferred Salinity (psu)
40.00,-141.75
GEOSAT TRACK G3-a (2101-2140)
31.75,-146.75
15:43:09
5/02/90
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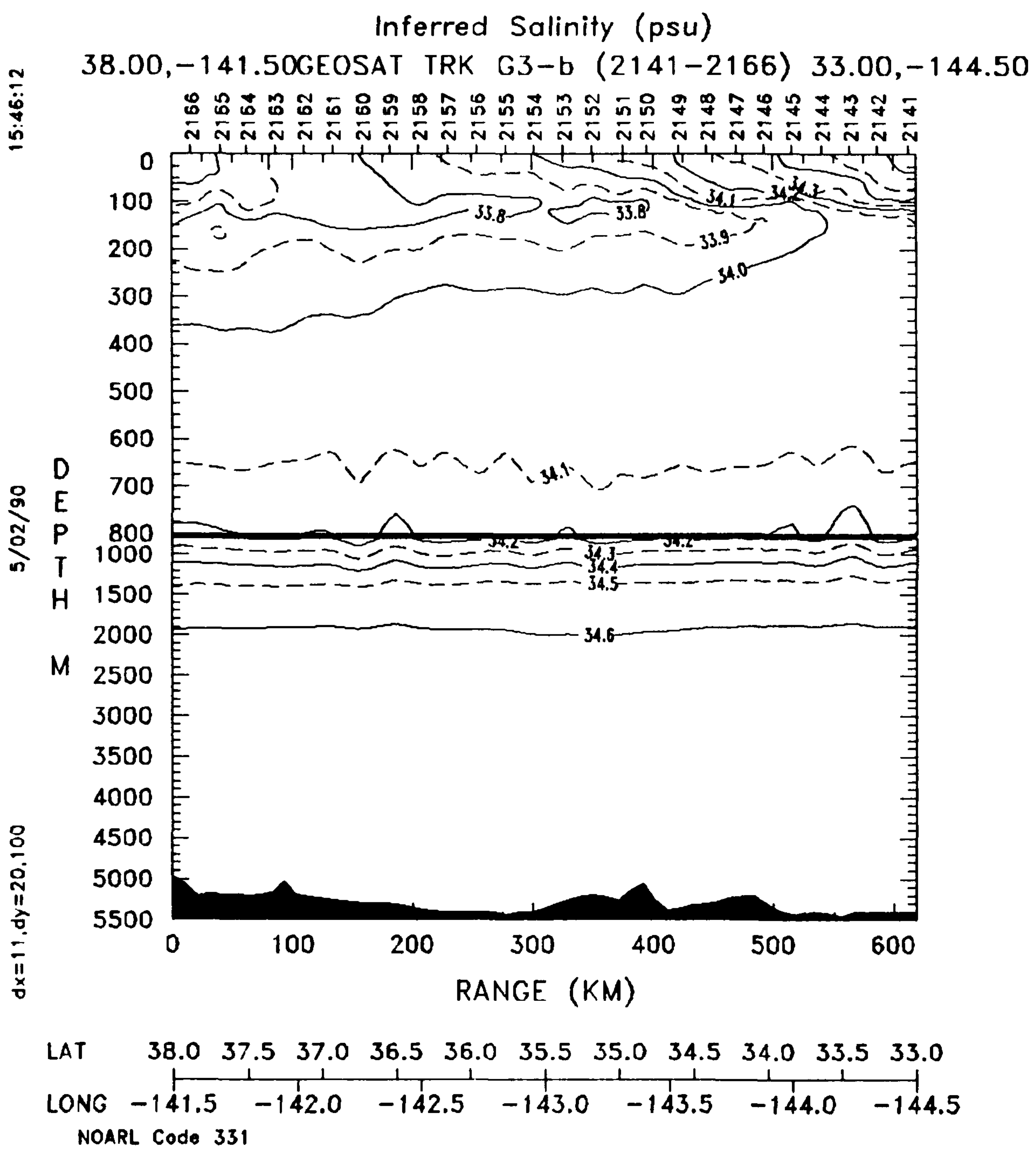
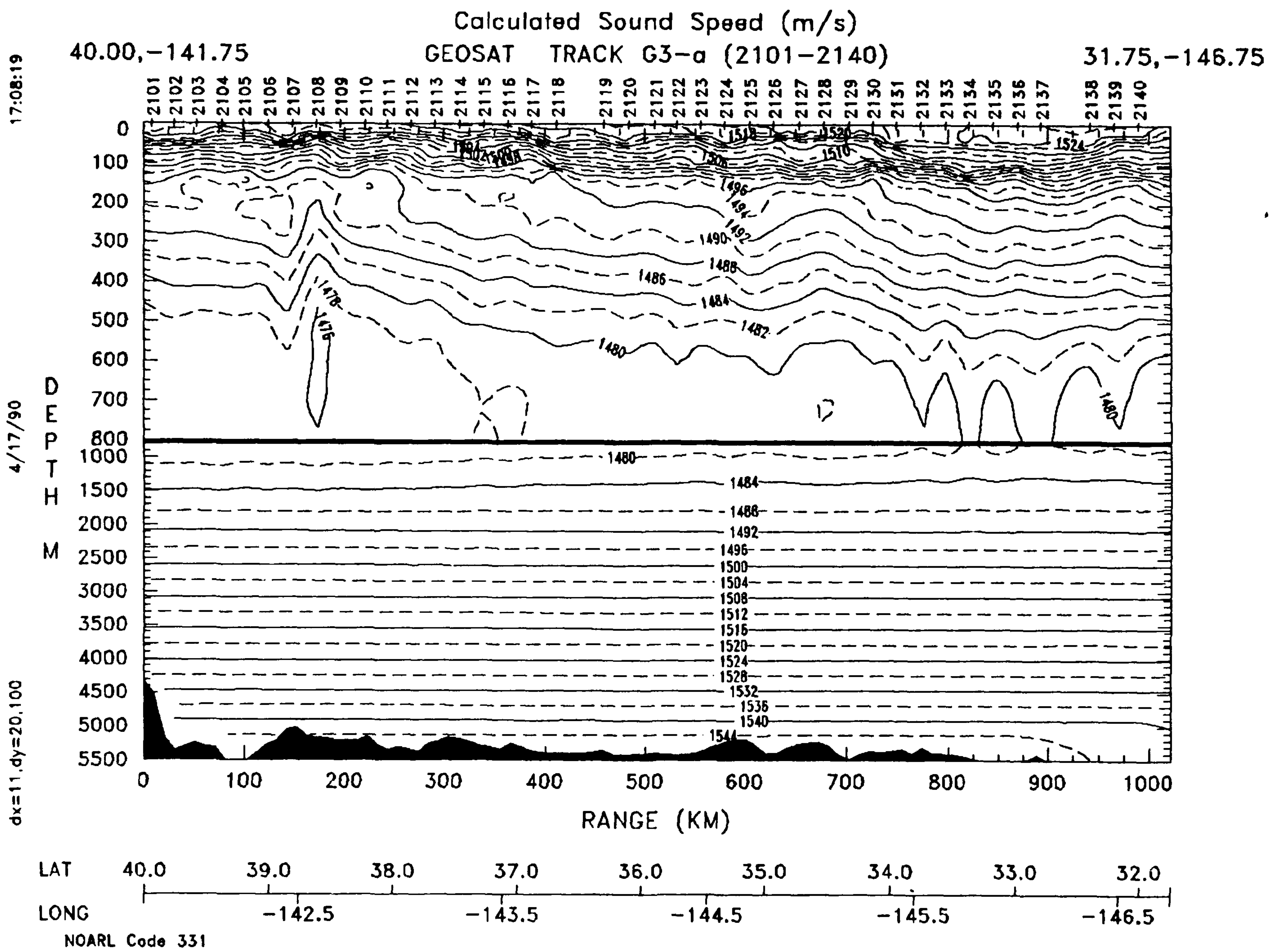
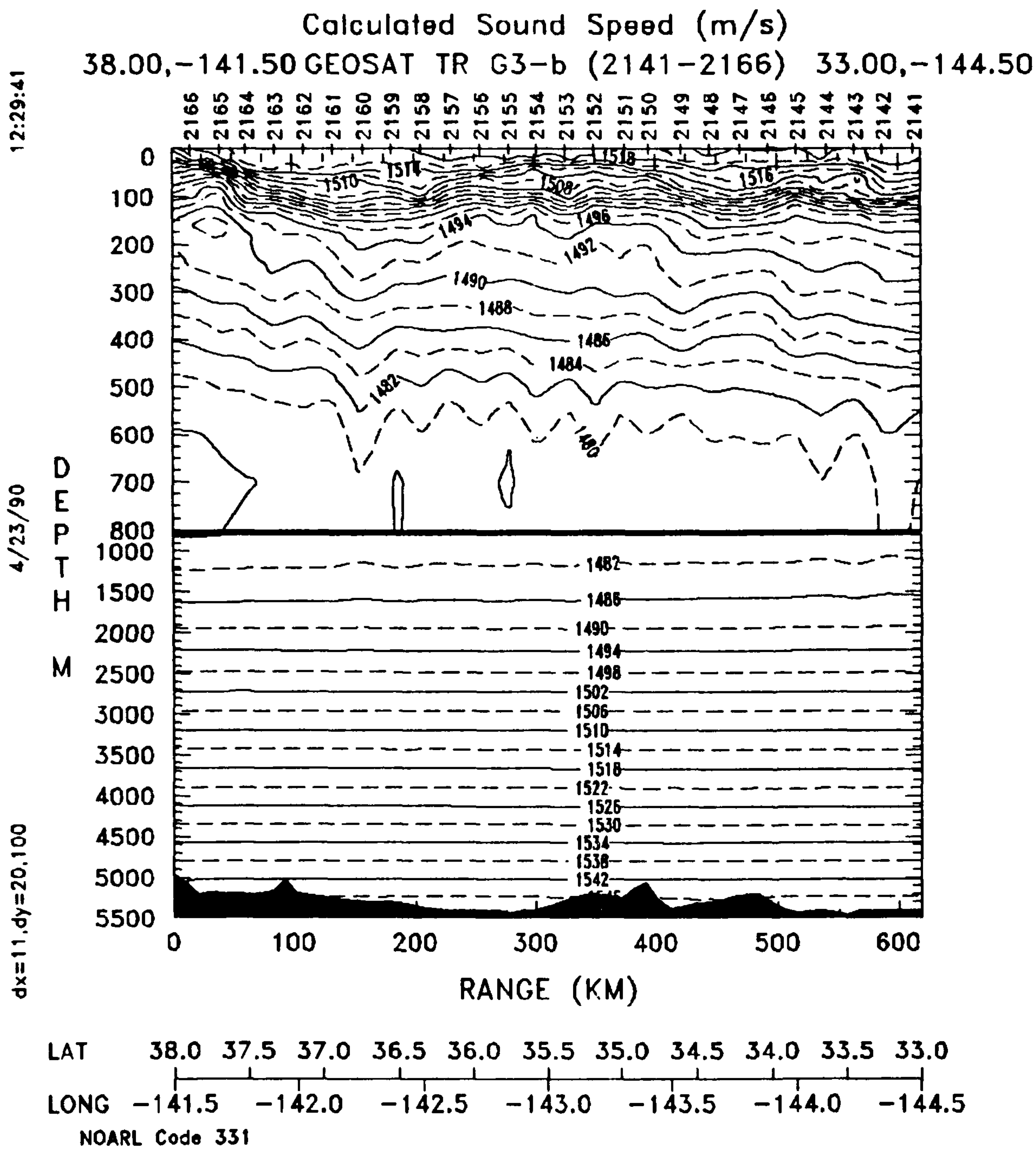
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331


Inferred Salinity (psu)
38.00,-141.50GEOSAT TRK G3-b (2141-2166) 33.00,-144.50
15:46:12
5/02/90
dx=11,dy=20,100
2166 2165 2164 2163 2162 2161 2160 2159 2158 2157 2156 2155 2154 2153 2152 2151 2150 2149 2148 2147 2146 2145 2144 2143 2142 2141
33.8
33.9
34.0
34.1
34.2
34.3
34.4
34.5
34.6
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
0 100 200 300 400 500 600
RANGE (KM)
LAT 38.0 37.5 37.0 36.5 36.0 35.5 35.0 34.5 34.0 33.5 33.0
LONG -141.5 -142.0 -142.5 -143.0 -143.5 -144.0 -144.5
NOARL Code 331



Calculated Sound Speed (m/s)
40.00,-141.75
GEOSAT TRACK G3-a (2101-2140)
31.75,-146.75
17:08:19
4/17/90
dx=11,dy=20,100
DEPTH M
RANGE (KM)
LAT
LONG
NOARL Code 331



Calculated Sound Speed (m/s)
38.00,-141.50 GEOSAT TR G3-b (2141-2166) 33.00,-144.50
2166 2165 2164 2163 2162 2161 2160 2159 2158 2157 2156 2155 2154 2153 2152 2151 2150 2149 2148 2147 2146 2145 2144 2143 2142 2141
DEPTH M
0 100 200 300 400 500 600 700 800 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
1510 1514 1518 1508 1516 1494 1496 1492 1490 1488 1486 1484 1482 1480
1482 1486 1490 1494 1498 1502 1506 1510 1514 1518 1522 1526 1530 1534 1538 1542
0 100 200 300 400 500 600
RANGE (KM)
LAT 38.0 37.5 37.0 36.5 36.0 35.5 35.0 34.5 34.0 33.5 33.0
LONG -141.5 -142.0 -142.5 -143.0 -143.5 -144.0 -144.5
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12:29:41
4/23/90
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Between 25 June - 19 July 1989, an experiment deploying over 800 deep shallow AXBTs was conducted in the subarctic frontal zone of the Northeast Pacific, between approximately 32° - 43° N, 138°- 151° W. The operation was part of the validation phase of the Naval Oceanographic and Atmospheric Research Laboratory's (NOARL's) Northeast Pacific Modeling Project (NEPAC). This document describes the experimental plan and the data acquisition and processing techniques used for the NEPAC experiment and presents the resulting data in graphical form.

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